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1946, No. 1 COPEIA April 30

Thomas Barbour

1884 - 1946

THESE LINES are not written to express my own deep sense of personal loss, nor are they addressed to those who knew Thomas Barbour and appreciated and loved him. They are written for and addressed to younger men in our science who did not know him, and may not know what herpetology was like in the days when he began his career. Nowadays young herpetologists are born with binoculars, Vernier calipers and slide rules in their mouths, with type specimens on museum shelves, and with big series of specimens available for the application of mathematical formulae. They are ill-equipped to appraise or appreciate Thomas Barbour, born, it is true, with a silver spoon in his mouth, but with Herpetology and his friends in his golden heart. I would like these younger men to realize how much his work has done to pave their way.

When Barbour began his career there was no system of type designation, subspecies were not restricted to geographical races, there was no COPEIA, there was no American Society of Ichthyologists and Herpetologists, there was no North American Checklist, there was no tradition of fieldwork by herpetologists, there were no field stations for study in the American tropics, habits and life histories were not considered worth attention in classification. The practice and study of herpetology is very different now, and to a very great extent this is due to the activity and influence of "TB," even though he himself remained more accustomed to see over the sights of a shotgun than through the lenses of a binocular and his opinion of mathematical formulae was unprintable.

Barbour's three delightful books of reminiscences give a quite good picture of his nature. His love of rare things, beautiful things, living things, his family, his friends and his projects are all there. The casual reader may fail to note one odd love of TB's,—the fascination that tiny lizards and frogs had for this man of more than average stature. The labor and expense devoted to *Sphaerodactylus* shows where his heart lay, and the last letter I received from him was about *Sminthillus*. *Anolis*, as everyone knows, was one of his pets. But TB's allusions to himself as modest, shy, and cowardly seem very strange to me. He was indeed modest about his own scientific work, and this, I think, came from early association with Stejneger, who had seen the systems come and go, and who was only assertive concerning nomenclature, dates, and types. TB was modest as far as gaudy newspaper publicity was concerned, but this certainly came from New England conservatism, Harvard "indifference," and any decent man's dislike for it. Modesty seems to me more a minor social grace than a virtue, and TB was perfectly capable of bragging about his luck, about his success in diverting a stream of specimens from some museum to the MCZ, about the MCZ collection, and about those people he liked or loved . . . and therefore considered his own. I have heard him do it and with gusto, and I am sorry that I shan't again. I think TB was modest

from a decent regard of the opinions of mankind rather than from temperament.

Shy he may have been as a youth, but a shy man does not bandy words with Gomez of Venezuela, nor does he retort in kind and completely "discombobulate" disreputable old women on Latin American streets!

I do not understand the self-accusation of cowardice at all, and no one ever thought it of him. True, he was somewhat given to "thinking too intently on the event" and he worried a good deal about himself, but that is not cowardice. He worried equally as much or more about the people and the institutions with which he was connected, and his concern about young men he sent into the field was extreme.

Barbour says of himself that writing did not come easily to him, and while his later works are very fluid prose one can find sentences in some of his earlier work in which he got pretty bogged down. What did come easy to him was conversation, and there he was by far the superior of any man I have ever known.

TB's conversation was completely *sui generis*. I have never heard anything remotely resembling it, nor can I find any parallels outside of Sidney Smith and the Elizabethans. In this field he was a superb artist, obviously giving himself pleasure in the exercise of his art, and obviously conscious that he was giving his hearers pleasure. But the art itself was not conscious. It welled up spontaneously as the talk went on and nothing he said was ever rehearsed beforehand. It was sheer gaudy play on the part of a man who loved language and the use of it, who loved much of the world as it is, including its quirks, who even found its stinks interesting, but who could also dislike some of it in no uncertain terms. He played with the English language as an Elizabethan might have done, using words as he pleased. He would even toy with his vocabulary. "Plain" was for a while everything derogatory, including conduct; "fancy" was all that he would say in the highest praise. But he often shifted from low gear (so to speak) to high, and leaving those barren New England uplands and lowlands he would scale the heights and plumb the depths of praise or blame in high astounding terms. His feats of "disenjeezalization" (= reducing of a situation, a topic or a theory to order and common sense) were fairly frequently displayed, and while they served well their intended purpose of deflation and rearrangement, they were also aesthetically edifying.

Many rather crude words, some well known, others archaic, were a regular element in TB's conversation. I do not mean it was obscene (it never was) but some pretty homely words were habitually used in highly erudite connections. And no allusion to the verbal gifts of TB could be complete without reference to his objurgatory powers. Here, to the native English and Irish, he added the Malay and the Spanish, plus a thorough acquaintance with the Arabian Nights in the version of Burton. His favorite oath "In the name of God the Great the Merciful the Severer of Delights the Sunderer of Companions the Hardener of Hearts the Garnerer of Graveyards" certainly stems from Burton, but the arrangement is pure TB.

Nowhere did Barbour's knowledge of places, plants, animals and men show as well as it did in "shop talk," and it was there too that his phenomenal

memory for names was so impressive. TB's verbal memory was almost equalled by a very keen visual memory. He could name off at sight more species in Herpetology than anyone I have ever known. He relied on his memory more than most workers do and it occasionally led him astray. It would be instructive, however, to compare the volume and quality of TB's work with that of any man who really followed the precept "never trust your memory." This ability was by no means confined to herpetology, as readers of his books will probably realize, but no one could have any true conception of this extraordinary faculty without seeing it in operation.

TB was very definitely of the type to whom we owe the origin of our science, "men who were in love with the world." We can be thankful that such men have continued to exist down to our time, and it behooves us now to encourage (as he so eminently did) and lend our feebler aid to others of the clan, that our science may not pass from the face of the earth and be entombed in laboratories.

Thomas Barbour started with one institution, the Museum of Comparative Zoology. He has left behind him at least two others, Soledad and Barro Colorado. Any one of the three would be a monument for any one man, as this alumnus of all three can testify with deep gratitude. He leaves behind him his own writings, especially the papers on the extraordinary array of valid new forms which disclose the rich speciation in the Antilles, and a very large body of work by other men, work which might never have been done or seen the light of day without his aid and encouragement. For years he helped make up the deficits which chronically afflicted COPEIA.

The number of younger scientists he helped and encouraged is extremely large and the list is by no means confined to herpetologists. His books give some idea of the continued interest and affection which he had for them. Theirs for him? TB can never die. He lives and will live in the hearts and minds of those who knew and loved him, and through them in others.

"Let us now praise famous men, and our fathers that begat us. Their seed standeth fast and their children for their sakes. Their bodies are buried in peace, but their name liveth for evermore."—EMMETT R. DUNN, *Haverford College, Haverford, Pennsylvania.*

A Lizard Population on Tinian

By Fred R. Cagle

THE abundant geckos in the vicinity of an army encampment on Tinian, an island of the Mariana Group, were studied during the period March to July, 1945. My objective was to accumulate data on the life cycles, to determine the approximate population of selected areas, and the extent of individual range. Opportunity for field study was limited but fragmentary information was secured on each of these topics.

Three species of geckos collected and designated as Forms A, B, and C were subsequently identified at the Chicago Museum of Natural History as *Lepidodactylus lugubris* (Duméril and Bibron), *Hemidactylus garnotii* Duméril and Bibron, and *Peropus mutilatus* (Wiegmann). *Hemidactylus,* the most abundant form, was studied by marking.

Area

The area selected for study (Fig. 1), 150 yards by 185 yards, included a large area of sugar cane (sections 1, 2), the former location of a Japanese village (sections 3, 4, 5, 6), a part of the trackway of a narrow gauge railroad (section 6a), and a Japanese park (section 1a). Small homes originally standing along the roads bordering sections 3, 4, 5 and 6 had been leveled to piles of debris. The trees and shrubs surrounding the homes had been little damaged and were flourishing.

Intensive collecting in sections 3a, b, c and 6a (bounded by dotted square, Fig. 1), provided the greater mass of the data reported here. Weekly collections were made in other sections to secure material for preservation and to determine extent of movements of marked individuals.

Methods

Lizards were collected during the day from under the debris of the destroyed homes, fallen trees, rocks, or the railroad ties. Each lizard was sexed, measured and marked at the site of its capture and immediately released. The body length was measured by placing the lizard on a wooden ruler, ventral side up, and placing the tip of the nose against a projection marking the end of the rule. The lizard was gently flattened and the body length determined as the length of the area between the tip of the nose and the posterior lip of the anus. Repeated trials indicated that this measurement could be made with an error of ± 1 mm.

Lizards were marked by clipping toes. In no instance did such clipping appear to interfere significantly with the lizard's usual activities. Eggs were collected only from sections other than 3 and 6 so that the normal population development in those sections would not be influenced.

Movements

Two sections were selected for intensive study of lizard movements. One, the former site of three homes, each bounded by a border of shrubs and

trees, was cluttered with miscellaneous debris from the flattened houses (Fig. 1). Pieces of tin, wood and concrete provided ample shelter for the lizards. The second section, 120 feet long by 35 feet included a wrecked, narrow gauge railway and the adjacent area.

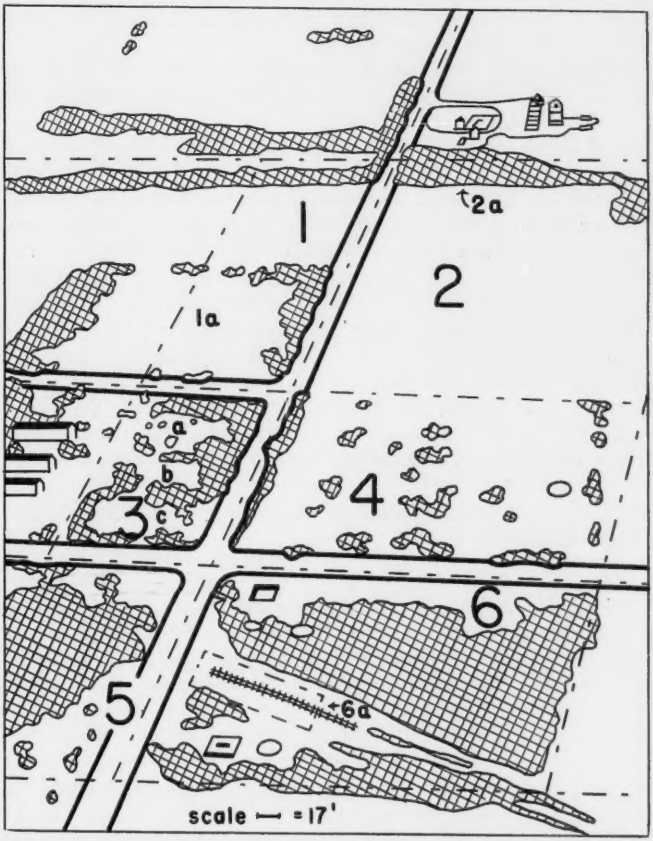

Fig. 1. A drawing prepared from an aerial photograph of the area studied. Areas 1 and 2 were cane fields with the exception of section 1a which was a Japanese park. Areas 3, 4, 5, and 6 were the locations of Japanese homes. The vegetation zones (cross hatched areas) bound the original home sites.

Forty-six stations, each a fragment of tin, concrete, or timber providing shelter, were established in section 3 (Fig. 1). Each station encompassed a maximum of 10 square feet. Specific stations were not designated in section 6a. All lizards were marked and released at the point collected.

Section 3a was studied until a labor gang was assigned to clean it up. The resulting removal of debris made collecting difficult and the significance

of the stations questionable. Of 58 lizards collected and released, 11 were recovered 1 to 4 times during a period of 62 days. All stations were examined in each of 21 visits to the section.

Recovery records indicate that the lizards return to the same resting site. In only 3 out of 23 recoveries were individuals found away from the station of release; two in Area 2 and another at a station 30 feet distant from the release point. Four lizards were recovered at the same station twice; 4 at the same station 3 times. One male released March 18 was recovered from under a small piece of metal roofing, April 18, May 29, and July 5; a female, April 18, 20, May 5.

Of 126 lizards released in section 6a (Fig. 1) 19 were recovered once; 28 twice; 6 three times; 1 four times—a total of 40 individuals recovered and 69 instances of recovery. Five individuals recovered outside of section 6 were all recovered in section 4. All other recoveries were within section 6 and 90 per cent of these within section 6a.

The tendency of the lizards to return to the same place of concealment each day is further emphasized by the record of one that had suffered an injured back and was easily recognized. This lizard was recovered 8 times under the same board between May 1 and July 5.

All collections were made during the day. Since the lizards are nocturnal and conduct their feeding and breeding activities at night, these data are only suggestive of the possible narrow limits of home ranges. Night observations could not be made because of the possible presence of unfriendly people and the nervousness of guards. No observations were made of lizards fighting, but most of the males collected had extensive scars about the head and anterior portions of the body.

Populations

A significant difference in relative abundance of the 3 species was noted in the 2 sections intensively studied. *Hemidactylus* was abundant in section 6a; *Lepidodactylus* and *Peropus* rare. Of 160 individuals collected from this section 153 were *Hemidactylus;* with 4 *Lepidodactylus;* and 3 *Peropus, Lepidodactylus* and *Hemidactylus* were both abundant in section 3, while *Peropus* was rare.

This distribution is correlated with the color patterns and habits of the forms. *Hemidactylus* was almost always collected from under ground debris and *Lepidodactylus* from the trunks of trees and the branches of shrubs. *Peropus* was collected only from moist, decaying material. The color pattern of *Lepidodactylus* is dominated by a wide light, mid-dorsal stripe crossed by a series of narrow, dark chevrons; the eggs are usually deposited on vertical surfaces to which they adhere; escape is attempted by jumping. *Hemidactylus* has a uniform, dark coloration when collected from concealment; the eggs are deposited under debris and do not have adhesive shells; escape is attempted by short runs. *Peropus* has a pattern of round, black spots on a uniform brown-black background.

Since it has been demonstrated that the lizards tend to remain within a given area, and as it may be assumed that the ratio of number of recoveries to number collected is the same as the ratio of number released to the total

population, we can determine the abundance of *Hemidactylus* by analysis of recovery records. Prior to June 26, 127 lizards had been marked and released in section 6a. On June 28, 10 lizards were collected of which 2 were recoveries; July 3, 11 with 1 recovery; July 4, 11 with 3 recoveries; July 5, 20 with 6 recoveries. None of these were hatchlings. These data indicate that the area supports approximately 500 individuals.

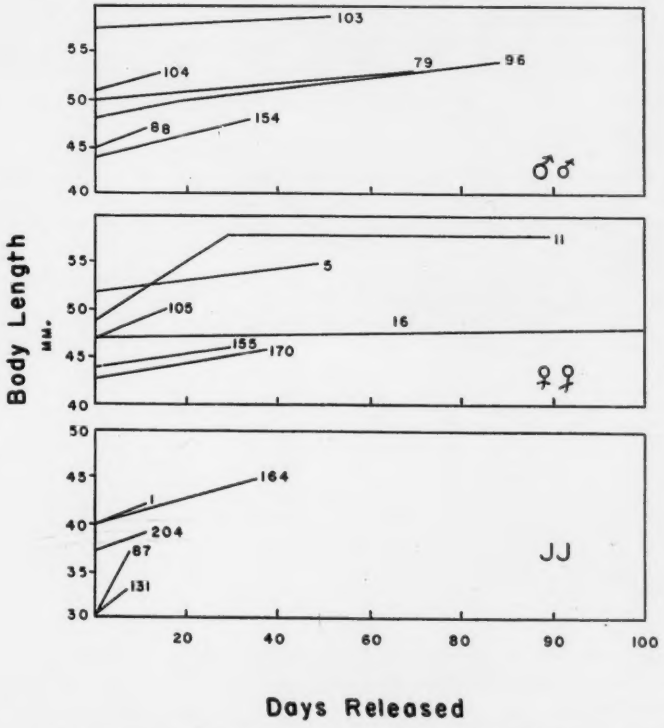

Fig. 2. The growth records of some individuals released and recovered.

The juveniles represented 25 per cent of the total collected; the adult males, 30 per cent; the adult females, 45 per cent.

The smallest female containing eggs measured 43 mm. in length. This point was assumed to be the minimum size of mature females and all larger than this were considered sexually mature. The males become sexually mature between the lengths 42-50 mm.

Growth

All juveniles released more than 5 days exhibited some growth (11 days, increased 3 mm.; 10 days, 8 mm.; 7 days, 2 mm.; 7 days, 3 mm.; 6 days, 1 mm.; 35 days, 5 mm.; 11 days, 2 mm.). Those released as hatchlings and

subsequently recovered (Nos. 87, 131, Fig. 2) grew more rapidly than any other individuals observed. The mean growth as calculated for 10 days for the size group 29-35 mm. was 6.20 mm. (Table I).

Mature females retain the ability of rapid growth until they reach maximum size. No. 11 (Fig. 2) exhibited rapid growth to a length of 58 mm. but did not increase in length during the next 40 days. Other mature females demonstrated rapid growth (155, 170, 105).

Other females may not increase rapidly in size once sexual maturity is attained. Thus female No. 16 increased only 1 mm. in 100 days. Other females failed to grow during long periods. Thus 5 females released for periods of 27-76 days failed to grow. None of these had reached the maximum size observed for females.

Sexually mature males may continue to grow rapidly (Fig. 2) to the maximum size although rapid growth as demonstrated by juveniles was not observed in males. Other males may grow very slowly after maturity is gained. Five adult males released 54–109 days failed to make any increase in length.

TABLE I

GROWTH CALCULATED FOR EACH 10 DAYS OF RELEASE.

			Growth per 10 days		
	Size Group	*No.*	*Mean mm.*	*Min. mm.*	*Max. mm.*
	29–35	5	6.20	1.81	8.00
	35–40	1	3.33	3.33	3.33
	40–45	4	1.90	0.60	2.73
M	45–50	3	0.80	0.60	2.73
F	45–50	9	1.68	0	3.10
M	50–55	7	0.30	0	1.30
F	50–55	10	0.30	0	2.00
M	55–60	1	0	0	0

The calculation of mean increase in body length for each 10 days of release for each size group provides a basis for an estimate of the time required for individuals to attain sexual maturity (Table I). Since an individual achieving the mean growth per 10 days of the first 3 size groups would have attained a size indicative of sexual maturity, we may assume that maturity is attained within 30–40 days after hatching.

EGGS

Forty-eight eggs of *Lepidodactylus lugubris* averaged 10 mm. in length and 4 mm. in diameter. The female apparently lays eggs on any vertical surface providing partial concealment. No eggs were collected with the shells still soft. Since the hardening time for the shell was determined as about four hours by observing egg laying in the laboratory and all eggs were collected during the day, I conclude that the eggs are deposited at night. This is a partial explanation of the repeated broods of eggs found completely exposed on the surface of a leaf (Fig. 4) or in an open crevice.

Fig. 3. The eggs of *Lepidodactylus lugubris*. A fragment of wood was removed to expose the eggs.

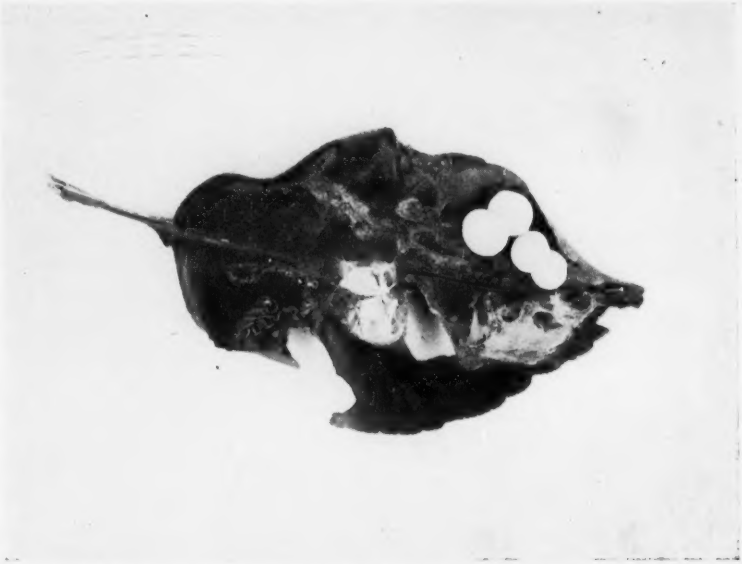

Fig. 4. An egg cluster of *Lepidodactylus lugubris* on a leaf. The eggs were exposed to direct rays of sun through most of the day.

The eggs occurred most frequently in groups of 2 or groups of 4 to 20. Clusters of eggs were repeatedly found. That such eggs were deposited at different intervals was indicated by the fact that they were not all adhering together and that the embryos were in various stages of development.

Eggs were found in large numbers in the decaying, hollowed ends of branches broken off during combat taking place in the area. These broods were sometimes completely concealed but were found during routine examination of such places (Fig. 3). In 10 square feet of broken shrubs 39 eggs were found deposited within the broken tips of the branches.

Sixty-three eggs of *Hemidactylus garnotii* averaged 12 mm. in length and 7 mm. in diameter. The thicker and more opaque shell was not adhesive. Such eggs were usually found in groups of 2–3 eggs under timbers, debris or within cavities in rotting wood.

Eggs of *Hemidactylus* were retained in the laboratory to determine incubation periods and to secure the young. The field-collected eggs were retained in match boxes with a bit of cotton and were examined daily. Of 254 eggs retained, 56 hatched prior to June 21. The maximum time eggs were retained prior to hatching was 45 days in 10 instances. Other long periods were 44, 41 (2 instances), 39 (2 instances) days.

The eggs were highly resistant to dessication and movement. The eggs were carefully handled but the opening and closing of the match boxes did result in much rolling about. No moisture was added to the boxes.

When the remaining eggs were opened June 21, twenty per cent showed no evidence of development or contained dead embryos. The remainder contained eggs in all stages of development. It is thus apparent that eggs are deposited throughout the months during which collections were made. The same observation applies to *Lepidodactylus lugubris*.

Food Habits

The stomach contents of 32 lizards (*Hemidactylus garnotii*) indicate that they feed on small invertebrates. Stomach contents included wood cockroaches, moth and beetle larvae, beetles, roach egg cases, grasshoppers, katydid pupae, and termites. Their capacity for ingesting large particles is demonstrated by the size of the insects taken—katydid, 20 mm. in length; grasshoppers, 25 mm.; moth chrysalis, 30 mm. No differences were noted in the food habits of males and females.

Department of Zoology, Tulane University, New Orleans, Louisiana.

Sexual Dimorphism in the Pelvic Spurs of *Enygrus*

By William H. Stickel and Lucille F. Stickel

While collecting in New Guinea the senior author noticed that in the common boid snake, *Enygrus carinatus* (Schneider), the spurs were absent or inconspicuous in females but well developed in males. Herpetologists have long known that the spurs, or vestigial hind limbs, of the Boidae are subject to some variation between the sexes. Boulenger (1913: 10) observes that the spurs are usually visible externally, at least in males. Sexual dimorphism in the size of the spurs of American boids was noted by the late Frank N. Blanchard (unpublished data).

D. Dwight Davis (1936: 274) has summarized the literature on the courtship and sexual dimorphism of snakes. Concerning the spurs of boids he says, "In the males of many species this structure is a comparatively large, curved hook, whereas in the female it is often reduced to a tiny horny projection (fig. 32). It is not known whether the hypertrophy of this structure in males is correlated with the onset of puberty, and the material at hand is not extensive enough to determine this by an examination of series of immature and adult specimens of both sexes."

Several authors have pointed out that the spurs are used to stimulate the female during courtship by scratching her body above the cloaca.

The presence of spurs is still sometimes used as a key character for the identification of the family Boidae. Since it does not seem to be well known that the spurs are absent in a large proportion of the individuals of some boids, a study was made of our specimens, now in the U.S. National Museum and the Museum of Comparative Zoology, and of all other specimens of this genus in the National Museum. Twenty-one females and eleven males were available.

The spurs were considered to be absent if they did not appear externally. They were measured in a straight line from insertion to tip. When the right and left spurs of a specimen differed in length, only the longer was plotted on the graph. The gonads of each specimen were examined and measured to determine whether the animal was mature. The snakes of the smallest size group were obviously newly born because of the unhealed umbilicus and the persistence of the yolk stalk.

The results of the study may be summarized as follows:

The spurs are present in all males of the series. They are well developed even in the newly born (200-250 mm. size group).

Spurs are absent in all of the juvenile females studied.

Spurs are absent in six of the nine females of mature size (i.e. in 67 per cent).

When spurs are present in females they are about half as long as in male snakes of similar total length, and are more or less concealed by the surrounding scales.

The spurs of males are curved into a hook. In females the spurs are straighter and more uniformly tapered.

The spurs of males do not undergo a sudden growth at the onset of puberty. Instead, they are conspicuous at birth, and inspection of the graph

suggests that they develop gradually in direct proportion to the growth of the snake in total length.

The left and right spurs are usually of the same size, but in either sex one spur may be as much as twice as long as the one on the opposite side.

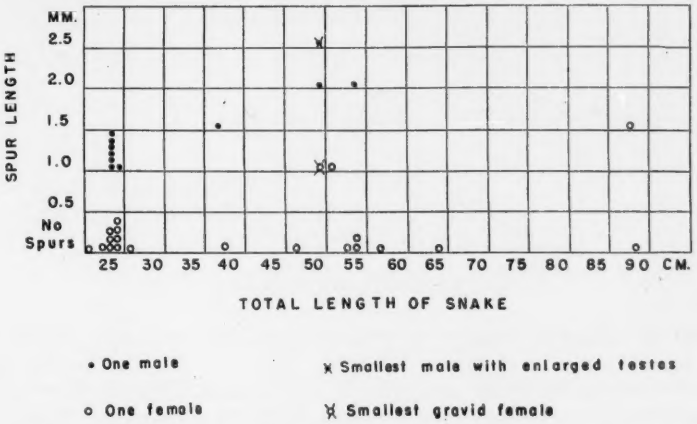

Fig. 1. Spur length and total length for males and females of *Enygrus carinatus*. Each spot represents one specimen.

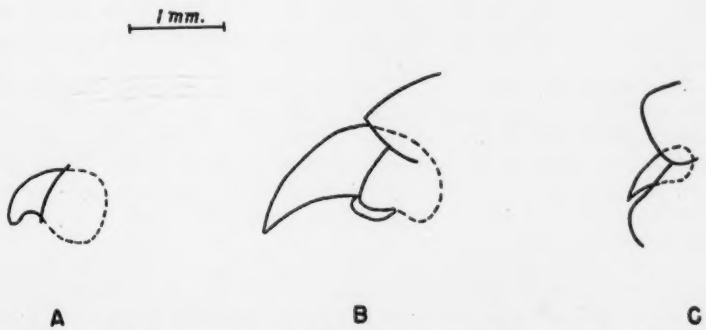

Fig. 2. Shape and relative size of the spurs of *Enygrus carinatus*. A, newly born male, 240 mm. total length, USNM 119738; B, adult male, 534 mm. total length, MCZ.; C, adult female, 503 mm. total length, MCZ.

The smallest male with enlarged testes was 492 mm. in length. The smallest female containing large eggs was also 492 mm. long. However, the series is too small to allow one to judge whether or not maturity is usually reached at a somewhat smaller size.

In the very distinct species, *Enygrus asper* (Günther), the spurs of males are much less curved than in *E. carinatus*, but are longer. Three males having total lengths of 230, 446, and 455 mm. bear spurs that are respectively 1.0,

5.5 and 3.0 mm. long. A single female of this species about 640 mm. in length, completely lacks spurs.

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Patuxent Research Refuge, Bowie, Maryland.

The Eustachian Tubes in the Crocodilia

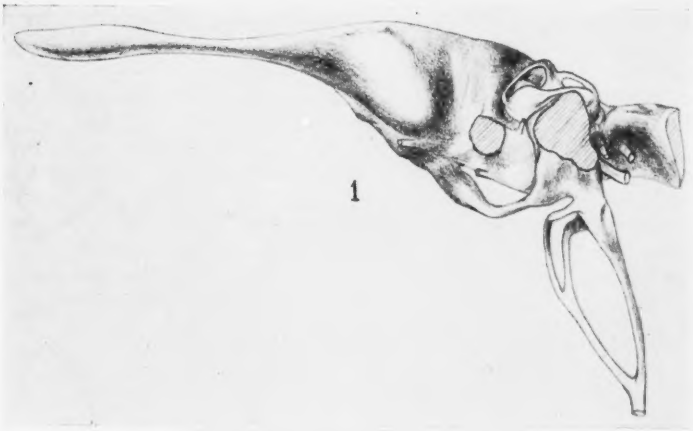
By Edwin H. Colbert

THE eustachian tubes in the Crocodilia probably are unique because of the complexity of their development. This is a fact that is not very widely recognized among anatomists or herpetologists, although it has been noted in the literature by various authors during the past century. It was in 1850 that Owen first described the eustachian passages in the Crocodilia in the Philosophical Transactions of the Royal Society of London, with the characteristic thoroughness so indicative of his keen powers of observation and of his great skill as a comparative anatomist. Indeed, to the best of my knowledge, no subsequent description has been as complete or as well documented.

Accompanying Owen's description are three plates, showing dissections of the skulls in certain crocodilians, but while these plates are accurate and well-executed, they fail to give an adequate picture of the complex courses and the branchings of the eustachian passages within the skull. This is perhaps the reason why the complex nature of the eustachian tubes in the Crocodilia has been overlooked by so many anatomists and herpetologists subsequent to Owen.

In 1878 Miall described the eustachian tubes in the Crocodilia, with an accompanying figure that gives a reasonably clear idea as to the courses of these passages and their relationships to each other. Again, in 1890, a description of the crocodilian eustachian tubes was given in Bronn's "Klassen und Ordnungen des Thier-Reichs," with an accompanying plate showing dissections of the skull. This work, like Owen's original description, fails in spite of its thorough description, to give an understandable picture of the eustachian tubes in these reptiles. Thus these publications have not added much to Owen's description.

The present paper is written in an attempt to show more satisfactorily than has been done in the past the manner in which the eustachian tubes connect the tympanic cavity and the throat in the crocodilians. The reason that previous figures (with the exception of Miall's rather simple diagrammatic sketch) have failed to give an adequate impression of the eustachian



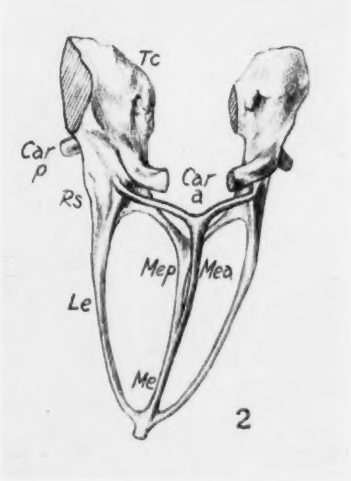


Fig. 1. Cast of endocranium and eustachian tubes of *Crocodilus acutus* Cuvier. Lateral view of left side, approximately natural size. The conjoined eustachian tubes are beneath the tympanic cavity and the semicircular canals.

Fig. 2. Tympanic cavities and eustachian tubes of the cast, shown in Fig. 1, as seen in an antero-oblique view. Somewhat enlarged over Fig. 1. Car—a, anterior exit of carotid artery from tympanic cavity (from whence it runs forward to enter the sella turcica); Car—p, posterior entrance of carotid artery into tympanic cavity; Le, lateral eustachian tube; Me, median eustachian tube; Mea, anterior branch of median eustachian tube, bifurcating dorsally to enter the right and left rhomboidal sinuses; Mep, posterior branch of median eustachian tube, bifurcating dorsally to enter the right and left rhomboidal sinuses; Rs, rhomboidal sinus; Tc, tympanic cavity.

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tubes in the Crocodilia is that they have been based upon skull dissections. And in this particular instance no figures of skull dissections, no matter how detailed, can possibly give a comprehensive understanding of the system of eustachian tubes as they branch and subdivide within the bones beneath the brain of the crocodilian skull. Only by withdrawing the tubes from the bone, and viewing them "in the open" so to speak, can they be properly shown.

Recently, in connection with a detailed study of a fossil crocodilian, an endocranial cast of *Crocodilus acutus* was made in the Paleontological Laboratory of the American Museum of Natural History. Casts of the eustachian passages were included in this endocranial cast, which was most skilfully prepared by Mr. Otto Falkenbach of the preparation staff. Figures by Mr. John C. Germann of this cast are presented here, together with a brief description of the crocodilian eustachian tubes.

As was shown by Owen in 1850, there is a ventrally directed median opening in the crocodilian skull, just behind the internal nares and at the junction of the basioccipital and the basisphenoid bones. This is the exit for a median eustachian tube. On either side of this foramen there is a very small foramen, also between the basioccipital and the basisphenoid bones, for the lateral eustachian tubes—seemingly the homologues of the paired eustachian tubes in other tetrapods.

The two lateral tubes and the median tube are continued ventrally below the bone as membranous tubes, which join at a point just below the median foramen and just behind the internal nares, and it is at this point that the eustachian tube system communicates with the throat.

The median eustachian tube passes upward through the basioccipital bone, and at some distance up from the foramen it divides into an anterior and a posterior branch. The anterior branch of the median passage continues forwardly into the basisphenoid bone, and in turn it divides into two lateral branches, right and left. Each of these lateral branches enters an enlargement of the lateral eustachian tube which Owen designated as the "rhomboidal sinus." From the rhomboidal sinus a single large opening connects with the tympanic cavity. In a like manner, the posterior median branch divides within the basioccipital bone, right and left, into lateral branches which enter the rhomboidal sinuses on either side.

This complex arrangement of the eustachian tubes appears to be constant within the various genera of modern crocodilians. Moreover, an examination of fossil material would indicate that these characteristic crocodilian eustachian passages can be traced back through geologic time, through the various suborders of Crocodilia, to the virtual beginnings of the order. Thus, this system of complexly divided eustachian tubes can be followed back in the Eusuchia through Cretaceous times. The system is seen in the relatively primitive Mesosuchia of the Mesozoic Era and also in the marine Jurassic Thalattosuchia. It is characteristic of the recently discovered Sebecosuchia, of which a detailed study has been prepared by the present author and is now in press. Whether this specialization of the eustachian tubes had taken place in the ancestral Upper Triassic or Lower Jurassic Protosuchia is not determinable in the present stage of preparation of the unique specimen of *Protosuchus*. However, for all practical purposes the complex eustachian system described above can be regarded as an ordinal character for the Crocodilia.

What is the purpose of such a highly developed system of branching passages between the tympanic cavity and the throat in the Crocodilia? This is a question that arouses the curiosity of anyone who has seen these peculiarly developed eustachian tubes.

Owen hazarded some thoughts on this problem in his original description of 1850 (525-526).

> I forbear, with my present limited experience of the living habits and actions of the Crocodilian Reptiles, to offer any hypothesis as to the function of the complex canals which conduct the air and would convey its sonorous vibrations from the nose to the ear; but one peculiarity I may suggest, as being probably related to the structures in question, in which the Crocodiles and Gavials differ from all the Lizard-tribe, viz. that of habitually floating with the operculated meatus externus submerged, and only the eyes and the prominent nostril exposed above the surface of the water. Any noise in the air that might reach the floating reptile would, under such conditions, be conveyed to the tympanum by the canals conducting to that cavity from near the hinder opening of the long nasal passage; and it may also be remembered, that there is a peculiar valve in the Crocodiles which shuts off all communications between that passage and the mouth.

The eustachian tubes, needless to say, are for the purpose of equalizing pressures on the internal and external sides of the tympanum. It is difficult to imagine sound waves passing through the nasal passage and then at right angles up through the branching eustachian passages to the *internal* side of the tympanum with any degree of effectiveness.

An alternative suggestion is that the branched passages in the crocodiles afford a more rapid equalization of air pressures on either side of the tympanum than would be possible with a single eustachian tube. However, one would expect one large eustachian tube on either side to be more effective than the small branched passages that characterize the crocodiles.

Still another possibility is that the branched passages may allow a direct equalization of pressures between the ears without the necessity of air passing down one tympanic tube to the throat and back up the other tube.

Perhaps it will be possible for someone to devise and carry out experiments that will afford a clue as to the reason for the complexity of the eustachian tubes in the crocodiles.

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Some Amphibians and Reptiles from the Gold Coast

By Grace L. Orton and Fred D. Morrison

WHILE stationed at Accra, Gold Coast, for several months during 1945, the junior author assembled a small herpetological collection which he subsequently presented to the Carnegie Museum. The specimens were all obtained within 15 miles of Accra. They were found in grass or bush-grass savanna, except for *Rana o. oxyrhynchus* and *Phrynobatrachus accraensis*, which were found in a nearly dry pond in an isolated clump of forest not over one-sixth of an acre in extent. Several are of particular interest because of their rarity in collections or because of noteworthy structural characters.

We are much indebted to Mr. Arthur Loveridge of the Museum of Comparative Zoology who kindly checked our determinations and, in particular, identified the juvenile *Rana o. oxyrhynchus* and called our attention to the description of *Phrynobatrachus accraensis*.

Rana occipitalis Günther.—Two adult females, CM 24691-92, found in a large water hole on May 29. The snout-to-vent lengths are 102 mm. and 72 mm., respectively. Although they differ greatly in size, both specimens are sexually mature, the ovaries being packed with pigmented eggs.

Rana oxyrhynchus oxyrhynchus Smith.—A just-transformed juvenile, CM 24694, still retaining the heavily pigmented tail-absorption scar, and measuring 15.5 mm. in snout-to-vent length. The specimen was collected on May 29 in a nearly dry pond under a dense growth of trees. The head is long and narrow; the legs are very long, the tibio-tarsal articulation extending far beyond the tip of the snout. There is a dark patch along the side of the head and the hind legs are barred, but the color pattern is otherwise poorly defined. Traces of several narrow longitudinal ridges are evident along the back. There does not appear to be an outer metatarsal tubercle. The feet are extensively webbed:

Toe number	1	2	3	4	5
Free phalanges	1½	½	½-1	2	0-½

Phrynobatrachus accraensis (Ahl).—An adult female, CM 24693, collected at the same time and place as the juvenile *Rana o. oxyrhynchus*. Although only 17 mm. in snout-to-vent length, the specimen contains heavily pigmented ovarian eggs.

This species was described by Ahl (1923) from a single 22 mm. specimen, sex not stated, and referred by him to his new genus, *Hylarthroleptis*. He distinguished this genus from *Phrynobatrachus* only on the basis of the presence of toe pads and constricted terminal phalanges in the former and the absence of such modifications in the latter. The frogs of this group are, however, still comparatively poorly known, and separation of them into two genera does not appear to be warranted.

The specimen at hand agrees fairly well with the original description of *P. accraensis*, although it differs in a number of details: the nostril is a little nearer to the tip of the snout than to the eye, instead of halfway between; the canthus rostralis is rounded, not particularly distinct; the interorbital space is nearly twice as wide as an upper eyelid, rather than as wide as; the

skin is slightly warty above rather than smooth; the throat and chest are light with dark dots rather than the reverse; and the toes are less fully webbed. There are minor differences in proportions of the snout, length of the femur relative to the body length, and length of third finger relative to length of snout; these discrepancies may result from different methods of taking measurements. In general, the differences between this specimen and the type description do not appear to be of taxonomic significance, but rather to fall within a normal range of variation.

The diagnostic characters of CM 24693 are: small size (female sexually mature at 17 mm. snout-vent length), small toe pads present, a tarsal tubercle and a small tubercle on heel joint, extended heel reaches a little beyond anterior border of eye, skin of dorsum slightly warty. The toes are webbed as follows (the toe pad includes the terminal phalanx):

Toe number	1	2	3	4	5
Free phalanges	2½	2	2	3	2½

The color of the preserved specimen is: dorsum dark brownish gray, a darker bar connecting eyelids and indistinct darker markings on back; an irregular dark band along side from above shoulder region to groin, indistinctly continuous with oblique dark stripe from eye to shoulder; rear of thigh with a pair of longitudinal dark stripes separated by a grayish stripe, exposed dorsal surfaces of femur and tibia banded; throat, chest, and underside of femur finely speckled with dark; lower lip irregularly spotted with dark.

This appears to be the second known specimen of *P. accraensis*.

Pelomedusa subrufa olivacea (Schweigger).—A juvenile, CM 24695, collected on May 29 from a rain puddle on a dirt road. Carapace length 33.5 mm., width 28 mm., height 13 mm. The specimen appears to be intermediate between typical *subrufa* and the doubtfully distinct *olivacea*. The left pectoral shield reaches the median line, but the right one is excluded.

Amphisbaena leucura Duméril and Bibron.—A single specimen, CM 24688, found dead on May 9, on the surface of freshly-dug clay soil. Total length ± 178 mm. (snout-to-vent ± 134, tail 24); 217 annular rings on body, 27 (+ tip) on tail; 23—25 segments in midbody annulae; 6 anal scales; 10 preanal pores; postmental scale present.

Philothamnus semivariegatus nitidus (Günther).—A female, CM 24685, found in a mango tree on April 22. Midbody scale rows 15, ventrals 170, caudals 100+ (tail incomplete), upper labials 9 (5th and 6th enter orbit, 4th barely excluded), temporals 1 + 2. Total length of alcoholic skin approximately 1134 mm. (snout-to-vent length ± 820, tail 314 +). Color green in life. The stomach contained a large toad.

Psammophis elegans (Shaw).—A juvenile male, CM 24687, found in a small bush on May 6. Scale rows 17–17–11, ventrals 186, caudals 159, left preocular partly divided, 2 postoculars, temporals 2 + 2. Total length 545 mm. (344 + 201). The color pattern appears to be entirely typical, although somewhat obscured by darkening.

Psammophis sibilans sibilans (Linnaeus).—Two females, CM 24686 and 24696, collected in a dry grassy area on April 24 and June 3, respectively. Mid-dorsal scale rows 17 in both, ventrals 168 and 161; caudals 104 in the first specimen, 50 plus *regenerated* tip (*vide* Loveridge, 1940: 3–4) in the sec-

ond specimen. In both, 5 lower labials are in contact with the anterior chin shields; upper labials 8, lower labials 11, temporals 2 + 3. Both specimens are partly skinned out. The total length and tail length are approximately 927 mm. and 312 mm. in CM 24686, and 625 mm. and 140 + mm. in CM 24696. In both snakes there is a pair of well defined sublateral dark lines on the ventrals extending nearly the full length of the body and tail, beginning just behind the neck region.

Causus rhombeatus (Lichtenstein).—Two specimens, CM 24689-90. The former is a skinned-out female collected on May 17. The midbody scale rows are 19, ventrals 139, caudals 19. Total length approximately 482 mm., tail length 42 mm. The much-elongated poison glands were left intact when the specimen was skinned. The second specimen, of which only the head was saved, was found in a rock pile on May 21. The stomach of each snake contained a toad.

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Notes on *Crocodylus novae-guineae*

By Wilfred T. Neill, Jr.

During military operations in Papua in 1943 and 1944 the writer had some opportunity to make observations on the New Guinean endemic crocodile, *Crocodylus novae-guineae* Schmidt.

This freshwater crocodile was found to be fairly common about 12 miles north of Port Moresby, Papua. The locality was one of shallow lakes, choked with reeds, cat-tails, water-lilies, and hydrophytic grasses. The lake margins supported dense stands of "curly-bark" (*Melaleuca*), palms, casuarinas, pandanus, figs, eucalypts, and other forms. Such areas, set amid arid grasslands, were veritable oases for the animal life of the region. Deer (*Cervus hippelaphus*) and wild swine (*Sus papuensis*) abounded. Characteristic waterfowl included cormorants (*Phalacrocorax*), grebes (*Podiceps*), gallinules (*Porphyrio* and *Gallinula*), lotus-birds (*Irediparra*), darters (*Anhinga*), and

egrets (*Egretta*). The most abundant reptiles in the swamp were *C. novae-guineae* and a species of *Emydura*. About the margins *Natrix mairii, Demansia olivacea, Physignathus temporalis,* and various scincids were often collected. Frogs occurred by the thousands, *Hyla mcgregori, H. infrafrenata, H. nasuta,* and a large ranid (tentatively identified as *Rana daemeli*) being the forms most frequently taken.

During the day, specimens of *C. novae-guineae* were found to secrete themselves around the edges of the marshes, either in thick grass or beneath piles of fallen timber. None was observed to bask in the open. When disturbed, individuals often ran for some distance through the shallow water and then attempted to hide amid clumps of aquatic vegetation. At night they were found in deeper water, resting almost vertically with the neck bent over at such an angle as to bring the eyes and nostrils to a level with the surface. Position was maintained by occasional strokes of the fore or hind limb. Several examples were seen to "dog-paddle" a considerable distance in this fashion. When approached, they would sink to a depth of a foot or more, then dive deeply to reappear at the surface 15 or 20 yards away. Individuals were found in the same spots night after night; after heavy rains and consequent flooding of the swamps, however, the crocodiles would distribute themselves over the area in a new pattern. It was found that small specimens, carefully stalked by boat, could be grasped by hand if first blinded by a light. One juvenile example, taken in this manner, voiced a series of high-pitched shrieks that provoked a large adult into charging savagely in the direction of the sound. The charge was not completed, the irate reptile submerging abruptly when but a few yards away. Such behavior suggests that the young are cared for by at least one parent for some time after hatching.

On November 8, 1943, a five-foot crocodile was discovered lying beside a large, hemispherical mound of dried grass in a patch of dense marginal vegetation. Upon the hasty departure of the beast, the writer examined the mound; it contained the remains of a young wild hog (*Sus papuensis*) in an advanced state of putrefaction. (Although the crocodile was not collected, it was almost certainly *novae-guineae*. *Crocodylus porosus* of that size was never observed in the area.) Farther on, a similar mound was found, this one also containing a small *Sus*. The guardian reptile had evidently been frightened away, for its tracks were plainly visible in the mud. Some species of crocodiles are said to cache large prey beneath submerged logs or overhanging banks, remaining in the vicinity until the carcass, softened by decay, can readily be torn apart and devoured; *novae-guineae* would appear to have evolved a technique more in keeping with its palustrine habitat. Small individuals seemed to feed primarily upon waterfowl. Stomach contents usually consisted of masses of black feathers, apparently those of the various rallid birds so common in the area. One specimen contained a fledgling "willy-wagtail" (*Rhipidura*). Another was seen to leap upward and seize a *Physignathus temporalis* that was sleeping on a reed overhanging the water.

Nests and eggs of the species were found in November, 1943. The nesting site was usually 20 or 30 feet back from the swamp, often on the higher ground bordering a lagoon, and invariably placed in an almost impenetrable tangle of vines and bushes. The crocodile usually lay in a well-worn path

between the nest and the water's edge. The nests were roughly hemispherical, about 45 inches in diameter and 26 inches in height. They were generally built at the base of a tree. The lower half of the nest consisted of pandanus leaves, reeds, and sticks embedded in a matrix of mud; the upper portion, containing the eggs, was a soft, dry mixture of *Melaleuca* bark, grass, and leafy debris, surrounded by a thin shell of mud and twigs. Slow oxidation of the nesting material generated considerable heat; one nest, completely shielded from sunlight by dense vegetation, showed a temperature of 39° C. on the inside. The eggs averaged 77 mm. in length and 49 mm. in diameter. The shells were hard but not brittle; they could be dented without breaking. The number of eggs in a nest varied from 23 to 35, such clutches being guarded by females of about 5 feet in length. On one occasion, a large specimen approached within a few yards of the writer as he was investigating a nesting site. The reptile hissed and thrashed about angrily until a movement in its direction brought about a precipitate retreat.

On July 8, 1943, a crocodile fell over Rouna Falls, on the Laloki River about 16 miles northeast of Port Moresby. Battered and stunned, it lodged at last in a rocky pool some distance below the falls. The writer reached it with considerable difficulty; it proved to be a *C. novae-guineae* 68 inches in length. This was the largest example of the species noted in eight months of collecting in the region.

C. porosus was taken in the Laloki River as far up as its junction with the Goldie River; none was observed above Rouna Falls, however. Occasional twelve- and fifteen-foot crocodiles, seen in the marshes, were undoubtedly *porosus;* a nine-foot example of this form was killed by soldiers in Waigani Swamp, an extensive marshy tract about 7 miles north of Port Moresby. Such specimens were probably wanderers from the near-by river, where both large and small *porosus* were common. According to the Papuan natives, very large crocodiles not only travel for long distances overland, but even occasionally take up residence for some time in thickets or bamboo groves, where they lie beside game trails in wait for prey!

A comparison was made of a living specimen of *novae-guineae* 790 mm. in length, and a living *porosus* of 863 mm. Certain differences were immediately evident. The former individual was olive-yellow above, with 5 or 6 black cross-bands. The proximal third of the tail was black-spotted, the remainder strongly banded with black. The belly was immaculate white, while the subcaudal region was dark brown. In contrast, the *porosus* was greenish-gray above with small black spots vaguely arranged in 7 or 8 transverse rows. The tail was also marked with black spots, which became larger and more band-like toward the terminal third. The belly was ivory, as was the subcaudal region. In this specimen the nape was covered with rather fine scales, with little trace of enlarged occipital scutes; in the *novae-guineae* all the scales of the nape (with the exception of the nuchals) were proportionately larger, and there were well-defined occipitals. The cranial table was barely trapezoidal in the *novae-guineae,* subrectangular in the *porosus*. The preorbital ridge was slightly larger and longer in the latter species. Both specimens agreed in having the dorsal shield composed of 10 longitudinal and 17 transverse rows of scutes, and in having 20 caudal verticils double-crested and

18 single-crested. When grasped, the *novae-guineae* often everted the scent glands on the ventral surface of the lower jaw. These organs were well developed, often being extended to a distance of about 20 mm. Such actions were not noted in the *porosus*, although the specimen was a male and showed external traces of the glands. In disposition the *novae-guineae* was considerably less irascible.

The foregoing notes indicate that *C. novae-guineae* is a small, inoffensive species of palustrine habitat, thus bearing out the observations of Schmidt in the Sepik River area.

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Department of Biology, Richmond Academy, Augusta, Georgia.

Egg Size in Poeciliid Fishes [1]

By Nevin S. Scrimshaw

In the Poeciliidae, a viviparous family of cyprinodont fishes, are found two species whose eggs appear to be the smallest recorded for any fish. Both *Heterandria formosa* and *Aulophallus elongatus* have attained a high degree of dependence on the mother for nourishment after fertilization. Their eggs show a great reduction in yolk. The other members of the family are generally considered to be ovoviviparous.[2] In the course of studies on embryonic development (Scrimshaw, 1944a, 1945) and of superfetation (Scrimshaw, 1944b) in poeciliid fishes, egg sizes and ovisac diameters were recorded.

1 Field work on Panama species was supported by a grant from the Penrose fund of the American Philosophical Society.

2 It has recently been pointed out that these species are not ovoviparous in the strict sense of the word as are the "viviparous" perches. The mother contributes nourishment equivalent to about 1/3 the initial dry weight of the egg to the embryo during development (Scrimshaw, 1945).

TABLE I [3]

EGG SIZE IN POECILIID FISHES

Species	Source	Material	Maximum Size of Unfertilized Ova in millimeters	Minimum Size of Fertilized Ova in millimeters
Allogambusia tridentiger	Panama	Live	....	1.35
Allophallus kidderi	Guatemala	Preserved	....	1.65
Aulophallus elongatus	Panama	Live	.61	.58
Belonesox belizanus	Guatemala	Preserved	....	4.10
Brachyrhaphis cascajalensis	Canal Zone	Live	2.02	1.9
Brachyrhaphis episcopi	Canal Zone	Live	1.78	1.65
Brachyrhaphis terrabensis	Panama	Preserved	....	*3.4*
Darienichthys dariensis	Panama	Live	1.84	*2.14*
Unnamed form	Guatemala	Preserved	1.76	1.68
Gambusia affinis holbrookii	Florida	Live	....	1.6
Gambusia dovii	Canal Zone	Preserved	1.89	1.9
Gambusia nobilis nobilis	Texas	Preserved	....	1.95
Heterandria formosa	Florida	Live	.40	.37
Lebistes reticulatus	Laboratory Stock	Live	2.1	2.0
Mollienisia sphenops	Canal Zone	Live	....	1.87
Mollienisia velifera	.....	Preserved	2.1	....
Poecilia vivipara	Puerto Rico and British Guiana	Preserved	....	1.47
Poeciliopsis infans	Mexico	Preserved	1.7	1.60
Poeciliopsis occidentalis	Arizona	Preserved	2.02	1.86
Poecilistes pleurospilus	Guatemala	Preserved	1.96	1.55
Pseudoxiphophorus bimaculatus	Guatemala	Preserved	2.56	2.08

[3] Figures in italics represent the best value available although ova near the time of fertilization were not obtained.

The embryos of this family are retained in the modified follicle or ovisac until parturition. The ovisac is spherical at first but becomes increasingly elipsoidal as development progresses. Therefore, two or more dimensions were usually recorded in the late stages. The measurements were made under a dissecting microscope equipped with an ocular micrometer. Measurements on material preserved in 10 per cent formalin and then transferred to 70 per cent alcohol ("preserved" in Table I) approximated those on living forms. Poorly preserved material may show considerable shrinkage.

TABLE II [4]

SIZE OF OVISAC WITH FULLY DEVELOPED EMBRYO

Species	No. Fertilized Stages Studied	Representative Maximum Ovisac Measurements in Millimeters
Allogambusia tridentiger	29	2.33 x 2.33
Allophallus kidderi	7	2.80 x 2.33
Aulophallus elongatus	17	6.73 x 4.34
Belonesox belizanus	3	8.1 x 7.1
Brachyrhaphis cascajalensis	35	2.8 x 3.0
Brachyrhaphis episcopi	30	3.25 x 2.94
Brachyrhaphis terrabensis	4	4.35
Darienichthys dariensis	7	2.69 x 2.95
Unnamed form	9	3.25 x 2.45
Gambusia dovii	16	2.74 x 2.60
Gambusia affinis holbrookii	12	4.0
Gambusia nobilis nobilis	8	3.58
Heterandria formosa	500	3.06 x 3.25
Mollienisia sphenops	24	3.55 x 3.73
Mollienisia velifera	3	3.5 x 4.8
Poeciliopsis infans	11	3.0 x 2.94
Poeciliopsis occidentalis	14	*3.5 x 4.2*
Poecilistes pleurospilus	11	3.5 x 2.8
Pseudoxiphophorus bimaculatus	5	4.53 x 4.20

[4] The italicized figures represent the largest embryos found but these were obviously not ready for parturition.

The minimum size of fertilized ova is given in Table I along with the maximum size of the unfertilized egg. The overlap of these measurements reflects the normal variation in egg size at fertilization. *Heterandria formosa* is seen to have the smallest egg and the smallest embryos (Table II). Turner (1937) reported the diameter of the fertilized egg in the species to be 0.7 mm. Upon further study (Scrimshaw, 1944) it became apparent that because of the unusual embryology of this fish he had assumed the youngest brood of embryos to be unfertilized eggs. This was acknowledged by Turner (personal communication, 1939) but has never been corrected in print. Fraser and Renton (1941) complicated the problem by misquoting Turner as stating the diameter to be 1.7 mm. They then proceeded to give the diameter of the preserved egg at the time of fertilization as 0.33 mm. By several hundred measurements I have found the diameter of the living ovum of *Heterandria formosa* at the time of fertilization to range from 0.37 mm. to 0.40 mm. with an average diameter of 0.38 mm.

The fish with the next smallest egg is *Aulophallus elongatus*. My measurements on the living eggs of specimens taken from the Rio Abajo, Panama, show them to approximate 0.60 mm. in their longest axis. The smallest egg size which I have seen reported is that of the common anchovy, *Anchoviella mitchilli*, stated by Breder (1936) to be 0.6 mm. in diameter. This author also gives a diameter of 0.05 mm. for the egg of *Osmerus mordax*, the smelt. However, the 0.05 actually refers to inches and the measurement should stand as 1.2 mm. (Breder, *in litt.* October, 1944).

The maximum size of the ovisac is an indication of the size of the young at parturition. Such measurements obtained for the poeciliid fishes studied are listed in Table II. The size of the embryos is a characteristic of the species. *Belonesox belizanus*, the largest of these species, also has the largest eggs and embryos. In general the smaller species have the smaller embryos. *Heterandria* and *Aulophallus* are excellent examples. The latter frequently exceeds 12 cms. standard length compared to a rare 3 cms. for *Heterandria*. Although the eggs of the two species are both minute, the difference in the size of the young at parturition (Table II) is striking.

The common egg size of oviparous fishes varies from 1.00 to 2.00 mm. with many species running as high as 7 and 8 mm. (Breder, 1937). Not only are the eggs of poeciliid fishes in general somewhat larger than those of oviparous families but they are also very large in proportion to the size of the fish. This is correlated with the greater size and independence of the embryo upon parturition compared to that of the oviparous fish upon hatching. It is also related to the fact that a relatively smaller number of eggs are fertilized in viviparous fishes. The minute size of the fertilized egg of *Heterandria formosa* and *Aulophallus elongatus* is exceptional and due to circumstances discussed above.

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Gorgas Hospital, Ancon, Canal Zone.

Investigations on the Subfossil Fresh-Water Fishes in the Soviet Union

By George Nikolsky

INVESTIGATIONS of the fish remains connected with the dwelling places of prehistoric man began as early as the last quarter of the 19th century. The first to study the fish bones obtained in the stations of prehistoric man of our country was K. T. Kessler. In 1882 he published his work on fishes found near Ladoga Lake. Since then material has accumulated which allows us to outline some stages in the history of the eastern European ichthyofauna.

Fish remains connected with palaeolithic man are very scarce. Thus far it has been possible to investigate only the discoveries made in Crimean caves (Tichij, 1929) and in stations near the town of Novgorod-Seversky on the banks of the Desna River, a tributary of the Dnieper (Nikolsky, *in litt.*, Lebedev, 1944). Examination of these two collections shows that during the last interglacial epoch the members of the genus *Salmo* were more common in the Black Sea basin than they are today. Furthermore, the occurrence of the ling, *Lota lota,* in the collection indicates that the climate of the period studied was more rigorous than that of today.

The discovery in the Crimean caves of large specimens of *Rutilus frisii* and *Lucioperca lucioperca* shows that in this interglacial epoch the mouth of some large stream, apparently the Palaeo Dnieper, had been situated more to the east than that of the modern Dnieper, i.e., not far from the place where the fish remains were found. At present those large fishes are very rare off the Crimean coast of the Black Sea.

In postglacial deposits, fish remains are more abundant, and they are useful for establishing essential differences between the ichthyofaunae of sub-boreal and modern times. For example, from materials found in neolithic stations in the Baltic Sea basin, a higher proportion of thermophilic fishes was obtained than occurs in that area now. Also, K. T. Kessler (1882) has shown that in the sub-boreal period, in Lake Ladoga basin, there had been a considerably greater abundance of *Silurus glanis,* of *Lucioperca lucioperca,* and of *Lucioperca volgensis.* The latter species now occurs solely in the Black and Caspian sea basins and is absent from the Baltic.

Still greater changes are observed to have taken place in the ichthyofauna of the White Sea basin (Nikolsky, 1935, 1936, 1943). Fish remains found in stations of the Onega River basin show that the ichthyofauna of the sub-boreal period included many species of fishes—40 per cent of the material—which were of southern origin, which now inhabit the Aral Ponto Caspian province and the Baltic region, and which have disappeared from the White Sea basin. The following species which occurred in the earlier period are no longer found in the White Sea basin: *Aspius aspius, Scardinius erythrophthalmus, Abramis ballerus, Silurus glanis.* Not only the specific composition but also the abundance of the fishes were different than they are today. In the Onega River basin it was the bream and other

1 Institute of Zoology, University of Moscow.

cyprinid fishes that predominated in the catches of the sub-boreal time. Likewise in the lower Dvina River the bream was more numerous than it is there today.

Certain features of the biology of fishes inhabiting the waters of northern Europe during the sub-boreal times were apparently different from conditions obtaining today. Thus the growth rate of the common perch of the Onega was much greater 5,000 years ago than it was 2,000 years ago and higher than it is now. This was true also of the bream from the same river. All the materials obtained from the White Sea basin indicate that the aquatic climate was milder than in our day.

In the southern part of the U.S.S.R., particularly in Middle Asia, on the other hand, the remains of the sub-boreal ichthyofauna show no great differences from today's ichthyofauna (Nikolsky and Radakov, in press). Fish bones found in the Kizilkum Desert among the remains of Kelteminar culture belong to limnophilic representatives of the Aralo Caspian ichthyofauna (*Cyprinus carpio, Abramis brama, Rutilus rutilus, Scardinius erythropthalmus, Barbus capito* and others). Except for the bream, the main game fishes of that period and area did not differ in average size from modern stocks. The modern bream is found to be of smaller size, probably only because of intensive fishing.

The absence of any difference in the specific composition of the ichthyofauna and in the size of fishes investigated leads to the conclusion that apparently no marked cooling has taken place in southern U.S.S.R. since sub-boreal times.

More numerous fish remains occur in later cultures dating from the beginning of our era. Fish bones are found in the Desna River of the Upper Dnieper basin (Lebedev, 1944), in the Kuban and the Don (Svetovidov, *in litt.*). They abound particularly in the Kama, Vetluga, Viatka, Oka and others of the Volga basin (Nikolsky, 1945) and in the Onega (Nikolsky, 1935) and Amu Daria rivers. Fish remains from these rivers show many differences from modern stocks in specific composition, in the growth rates, and in other biological features. Hence it may be concluded that the changes observed are the results of a direct or indirect influence of man's activities. A diminution of forests in river basins altered the conditions of river flow. This prevented some migratory species, mostly the autumn spawning salmonids, from ascending certain tributaries of these rivers. Thus their populations became greatly reduced. Represented among fish remains obtained on the Vetluga was *Stenodus leucichthys*, a species not now inhabiting that river. According to Professor A. Derjavin (Kessler, 1882), *Salmo trutta caspius* was formerly abundant in the Volga basin and ascended the Oka for spawning, but is now very scarce there. Not only have autumn spawners been influenced by changes in river conditions but some of the migratory spring spawners have changed their distribution within the last 2,000 years. The remains of *Acipenser stellatus* were found in the upper Don by Svetovidov (*in litt.*), but today that species does not ascend so far.

Near the Desna River Lebedev (1944) found the bones of *Rutilus frisii*, a migratory cyprinoid fish which is today very scarce in the upper part of the Dnieper and entirely absent from the Desna.

The distribution, the growth rate and even the age composition of the fish populations were different 2,000 years ago than they are today.

Reduction in mean length resulting from exploitation is marked among many of the species represented in the collections. For example, remains of the sterlet, *Acipenser ruthenus,* the bream and other species in the Volga, the sturgeon, carp and catfish in the Kuban, the bream, catfish, pike, perch and others in the Desna included specimens much larger in size than are found in the same waters today.

On the other hand, diminution in the number of game fishes has reduced competition for food and that has brought about a higher growth rate in the modern populations than obtained 2,000 years ago.

Such briefly are the results of a study on fresh-water fish remains in relation to man's culture in the territory of the U.S.S.R.

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Institute of Zoology, University of Moscow, Moscow, U.S.S.R.

A New Species of Flatfish, *Cyclopsetta decussata* (Pleuronectidae), from the Texas Coast

By Gordon Gunter

Cyclopsetta ***decussata,*** sp. nov.

DORSAL 82, anal 64, pelvics 6, subequal, pectorals 12, scales about 75. Measurements in millimeters: total length 233, standard length 186, depth 86, head 53, orbit 11.5, snout 10, maxillary 28, interorbital 2, width caudal peduncle 20, length pectoral fin 30, width pectoral base 7.

In standard length: depth 2.16, head 3.50, pectoral length 6.20, pectoral base 26.5, width caudal peduncle 9.30. In head: orbit 4.61, snout 5.3, maxillary 1.89, interorbital 26.5. Percentages of standard length: depth 47.2, head 28.5, pectoral length 16.2, pectoral base 3.8, width caudal peduncle 10.8. Percentages of head: orbit 21.7, snout 18.8, maxillary 52.7, interorbital 3.8.

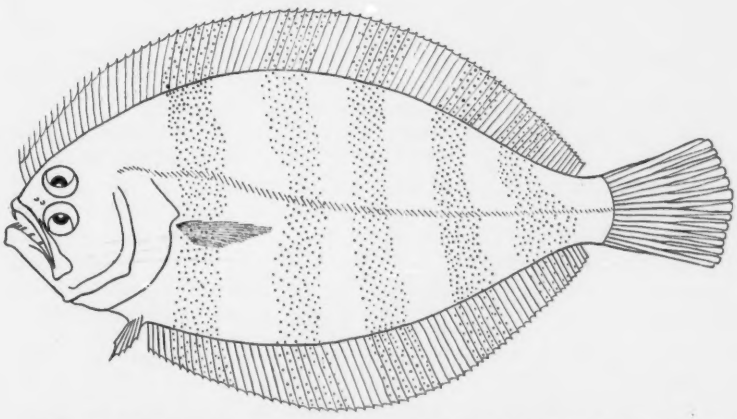

Fig. 1. A diagrammatic drawing of the mounted specimen. The edges of the color bands are not so sharp as shown in this drawing.

The fish is slightly deeper than species previously described. The eyes are close together, the orbits being separated only by a narrow ridge. Neither eye is more anterior than the other. The upper eye is close to the border of the head. The dorsal fin begins just in front of the upper orbit. The maxillary extends to the posterior border of the orbit. The teeth are fairly long and curved and there are two canines in the upper jaw. The pectoral fin of the eyed side is narrow, long and pointed, with the lower ray about one-fourth the length of the upper rays. It is 1.77 in head. The tubules of the lateral line are profusely branched, similar to those of *Cyclopsetta querna* (Jordan and Bollman) of the Pacific, and the lateral line forms a shallow groove from

2 to 3 mm. wide. The anterior third of the tail is scaled. The tail is double-truncate.

In color this fish is strikingly different from others of the genus. The blind side is colorless. The base color of the eyed side is light brown. Five darker brown bars or bands cross the body from fin to fin. The first runs through the pectoral fin and the last is at the anterior end of the caudal penduncle. The edges of the bars are not sharp, but the bars are quite distinct. They are about 10 mm. wide and are separated by pale areas of greater width. The third and last bars are prolonged as distinctly blackish areas on the fins and the other bars show more lightly on the fins. The posterior third of the caudal fin is also black. The diagrammatic drawing shows the color pattern.

The type and only specimen was taken in a try-net on August 12, 1945, approximately 40 miles south of Port Aransas, Texas, at a depth of 26 fathoms. Unfortunately the collector, an ardent taxidermist, carried the fish home, made a plaster cast of it and mounted the skin and head over it before I saw it. Since it is an exact replica in shape and the head was saved, the proportional measurements are about as good as could be obtained from a preserved fish. The gill-rakers are gone of course, and some of the teeth may be missing. The fins are slightly frayed. I was told by Mr. Joel W. Hedgpeth, Marine Biologist for the Texas Game, Fish and Oyster Commission, who saw the fish when it was caught, that the color bands were more distinct in the fresh fish than in the mounted specimen.

This fish seems to bear a closer resemblance to *C. querna* than to others of the genus in body shape, nature of the lateral line and closeness of the dorsal eye to the border of the head. In the proportion of head length to body length, and pectoral to head it is similar to *C. chittendeni* and *C. fimbriata*. In coloring it differs from all known species of *Cyclopsetta*.

Since the type of the species, which is now deposited in the U. S. National Museum, No. 123802, is a plastotype with the original head and skin, the first good specimen taken in the future should be designated a neotype.

INSTITUTE OF MARINE SCIENCE, THE UNIVERSITY OF TEXAS, ROCKPORT, TEXAS.

Fish Production in Lakes as a Guide for Estimating Production in Proposed Reservoirs

By GEORGE A. ROUNSEFELL [1]

A LARGE number of artificial reservoirs are being proposed for early construction throughout the United States, which in many cases will have a profound effect on fish and wildlife. It has become imperative, therefore, to attempt to evaluate this effect prior to the completion of construction plans, in order to obtain such modifications in design or water utilization as will assure the maximum benefits to fish and wildlife compatible with other uses and values.

This paper touches on only one phase of this evaluation—the quantities of fish that the proposed reservoirs may be expected to produce. Opinions on this subject vary from extreme pessimism to rosy optimism, depending largely on the observers' experience. Admittedly, there is a tremendous difference in the potential yield of various bodies of water, from the 200-pounds (or better) per-acre yield of the fertilized, properly-stocked farm pond to the one-pound-per-acre yield of Lake Superior. Yet it is possible to create a useful yardstick by studying observed production data. Such a measure of yield, based on actual experience, is bound to give a more reliable estimate than pure guesswork.

There are two types of data available on the populations of fish in lakes and ponds: total populations and annual yields. Unfortunately, both types of data are rarely available for the same body of water. Total population data are available only for small lakes and ponds, chiefly ones in which the fish have been poisoned. Generally speaking, only those ponds have been poisoned whose populations were abnormal in some respect. Either the natural balance between the larger predators and the smaller fish had been upset in such a manner that the lake was crowded with stunted panfish, or the lake had become heavily populated with carp, buffalo, or other rough fish, to the detriment of more desirable species. Obviously, the data from these atypical lakes are not truly representative of the average lake; but being the only data available they are presented for what they are worth. Statistics on the annual yield of lakes are better than those on total populations because they usually refer to lakes with more or less normal populations.

All the available literature on lake production has been examined, and the pertinent data compiled as shown in Table I. However, it was necessary to omit, for various reasons, certain ponds and lakes from consideration. For instance, the annual yield for Standard Lake (16.0 acres) given by Beckman (1941) referred to fish stocked immediately after the poisoning of the entire population, and thus does not represent the yield from a normally balanced population. Cahn (1939) gives the weight of carp taken from Neosha Mill Pond in southern Wisconsin, but not the area of the pond. A preliminary creel census of the trout catch in Fish Lake, Utah, given by Hazzard (1935) is omitted since the study covered but 13 days. Total yields from certain

[1] Fish and Wildlife Service, United States Department of the Interior, Washington, D.C.

TABLE I

FISH PRODUCTION PER ACRE OF LAKE SURFACE

Lake	Locality	Area	Fish production			Principal types of fish[1]	Authority
			Total population	Annual yield			
				Sport	Commercial		
		(acres)	(pounds)	(pounds)	(pounds)		
Crystal Lake Club	Ill.	0.75	358			R, Cp	Bennett (1943)
Farmer City	Ill.	0.75	455			R, Cp	Bennett (1943)
Delta Pond	Ill.	0.80	234			B, P	Bennett (1943); Thompson & Bennett (1939c)
Edwards Pond	Ill.	1.00	398			Bf	Bennett (1943)
Jasper-Pulaski Pit	Ind.	1.0	117			B, P	Ricker (1942b)
Upper Twin	Ill.	1.08	392			P, R	Bennett (1943)
Waltonian Pond	Ill.	1.10	71			B, P	Bennett (1943)
Kline's	Ill.	1.30	230			Bf, P	Bennett (1943)
Lower Twin	Ill.	1.36	778			R, P	Bennett (1943)
Fork	Ill.	1.38	539	161.9		R	Bennett (1943); Bennett, Thompson & Parr (1940)
Jack's	Ill.	1.50	221			P, F	Bennett (1943)
Shell	Ill.	1.50	215			Bf, P	Bennett (1943)
Pond 4	Mich.	1.6	113.4			R, B, P	Greenbank (1941)
Boddie Pond	Ala.	1.78	219			B, F	Tarzwell (1941a)
Pond	Ala.	1.8	167			B, P, F	Swingle & Smith (1939)
Little Steep Pond	Fla.	2 1	105.2			B, P, R	Meehean (1942)
Onized	Ill.	2.14	206			B, P	Bennett (1943)
Triangle Pond	Ill.	2.50	487			Cp,F,P	Bennett (1943)
Homewood	Ill.	2.83	699			R	Bennett (1943); Thompson & Bennett (1939c)
Duck Pond	Ill.	3.10	673			R, Cp	Bennett (1943)
Section Four	Mich.	3.3	23			P	Eschmeyer (1938b, 1938c)
Sportsmen's	Ill.	3.70	341			R, P, B	Bennett (1943); Thompson & Bennett (1939b)
Black Jack	Ill.	4.00	280			Cp, R	Bennett (1943)
Big Prairie Pond	Fla.	4.00	60.8			B, P	Meehean (1942)
West Lost	Mich.	4.00		23.0		Tr	Eschmeyer (1938a)
South Twin	Mich.	4.3	29			P	Eschmeyer (1937b, 1938c)
Lost	Mich.	4.6		21.0		Tr	Eschmeyer (1938a)
Duck Island Farm	Ill.	4.90	316			R, Cp, P	Bennett (1943)
McCormick	N. S.	6	8.4			Tr	M'Gonigle & Smith (1938)
Hemlock	Mich.	6.0		6.15		Tr	Eschmeyer (1938a)
Fitzek	Mich.	6.2	19.2			B, P	Greenbank (1941)
Crystal	Ill.	6.30	658			Cp	Bennett (1943)
First Pond	Fla.	7.	110.4			B, P, R	Meehean (1942)
Glen Major	Ont.	8.		35		Tr	Harkness (1941); Ricker (1942)
Southside C. Club	Ill.	8.40	719			F,P,Cp	Bennett (1943)
Buck's Pond	Ill.	8.60	1145			Bf, Cp	Bennett (1943); Thompson & Bennett (1939c)
Springwood[2]	Ind.	10	186			P, B	Ricker (1942b)
Third Sister	Mich.	10	86.7			P	Brown & Ball (1943)
Doyle[3]	Mich.	10		60.8		P, B	Hazzard & Eschmeyer (1938)
Ford	Mich.	10.7	49			F, P	Eschmeyer (1938b, 1938c)
Pearen's	Ont.	11		50		Tr	Harkness (1941); Ricker (1942)
Clear	Mich.	11.3	194			B, R	Eschmeyer (1938c)
Weldon Springs	Ill.	12.10	409			F, Cp	Bennett (1943); Thompson & Bennett (1939c)
East Twin	Wis	13	186			Cp, R	O'Donnell (1943)
Howe	Mich.	13.4	38			B, R	Eschmeyer (1938c, 1939b)
West Twin	Wis.	13.5	92			Cp, R	O'Donnell (1943)
Standard	Mich.	16.0	21			B, P	Eschmeyer (1938c)
Buck Pond	Fla.	18	32.7			B, P	Meehean (1942)
Clearwater	Fla.	24	22.2			B, P	Meehean (1942)
Long	Wis.	27.1	135			Cp, R	O'Donnell (1943)
Frog	Calif.	30		10		Tr	Curtis (1941)
Anderson	Wis.	38		3.9		P, B	Elkins (1937)
Shoe	Ind.	42	148	46		P, B	Ricker (1942a)
Jesse	N. S.	45.0	19.9			P	Smith (1935a, 1935b, 1938)

TABLE I (continued)

Lake	Locality	Area	Fish production			Principal types of fish[1]	Authority
			Total population	Annual yield			
				Sport	Commercial		
		(acres)	(pounds)	(pounds)	(pounds)		
Richter	Wis.	46		8.6		P, B	Elkins (1937)
Foots Pond	Ind.	47.5	145			R, B	Lagler & Ricker (1943)
Tedford	N. S.	52.0	36.0			P	Smith (1938)
Boar's Back	N. S.	55.8	17.0			R, P	Smith (1938)
Cedar[2]	Mich.	56		29.6		P, B	Hazzard & Eschmeyer (1938)
Crooked[2]	Mich.	70		41.5		P, B	Hazzard & Eschmeyer (1938)
Pleasant[2]	Mich.	86		63.1		P, B	Hazzard & Eschmeyer (1937)
Beaver	Alta.	90		18.3		Tr	Rawson (1941)
Potter's	N. B.	113	9 7			R, P	Smith (1941)
Clear[2]	Mich.	136.7		21.5		P, B	Hazzard & Eschmeyer (1938)
Budd[2]	Mich.	150		50.6		P, B	Hazzard & Eschmeyer (1937)
Clear[2]	Mich.	160		2.6		P, B	Hazzard & Eschmeyer (1937)
Whitegull	Ont.	188		1.9		Tr	Fry (1939)
Winagra	Wis.	200	357			Cp, R, P	Juday (1938)
Mill[2]	Mich.	204		23.9		P, B	Hazzard & Eschmeyer (1938)
Sugarloaf[2]	Mich.	204.8		15.1		P, B	Hazzard & Eschmeyer (1938)
Delta	Wis.	207		4.6		Pk, P	Elkins (1937)
June	Calif.	310		36.9		Tr	Curtis (1941)
Bear[2]	Mich.	375		1.9		P, B	Hazzard & Eschmeyer (1937
Clear[2]	Mich.	380		2.7		P, B	Hazzard & Eschmeyer (1937)
Island	Minn.	383		2.56		B, P	Eddy (1941)
Portage[2]	Mich.	480		11.5		P, B	Hazzard & Eschmeyer (1938)
Eighth Crow Wing	Minn.	492		19.1		P	Eddy (1941)
Fife	Mich.	800		10		B, P	Eschmeyer (1936, 1937a, 1939a)
Paul	B. C.	986		10.14		Tr	Mottley (1940); Rawson (1934)
Redrock	Ont.	1,130		1.3		Tr	Fry (1939)
Pike & Round	Wis.	1,300		2.8		Pk, W	Elkins (1937)
Deer	Minn.	1,845		2.64		Pk, W	Eddy (1941)
Waubesa	Wis.	2,034		18.		B, P	Frey, Pedracine & Vike (1939)
Merchant	Ont.	2,730		2.8		Tr	Fry (1939)
Kegonsa	Wis.	3,145		9.5		B, P	Frey, Pedracine & Vike (1939)
Maligne	Alta.	5,360		0.26		Tr	Rawson (1941)
Opeongo	Ont.	13,400		0.7		Tr	Fry (1939); Hart (1941)
Wilson[4]	Tenn.	15,500			32.0	Various	Tarzwell (1941b); Bryan & Tarzwell (1941)
Norris	Tenn.	34,200		4.6		B, P	Eschmeyer (1942)
Pickwick[4]	Tenn.	46,800			15.5	Various	Tarzwell (1941b); Bryan & Tarzwell (1941)
Wheeler[4]	Tenn.	68,300			19.0	Various	Tarzwell (1941b); Bryan & Tarzwell (1941)
Dauphin	Man.	128,000			11.48	W Pick	Cunningham (1935)
St. Clair[5]		294,400			5.0	Various	International Board of Inquiry (1943)
Manitoba	Man.	1,163,000			5.36	Various	Cunningham (1935)
Winnipegosis	Man.	1,335,000			3.26	Various	Cunningham (1935)
Ontario[5]		4,826,000			0.8	Various	International Board of Inquiry (1943)
Erie[5]		6,362,000			8.4	Various	International Board of Inquiry (1943)
Michigan[5]		14,336,000			3.3	Various	International Board of Inquiry (1943)
Huron[5]		14,726,000			1.4	Various	International Board of Inquiry (1943)
Superior[6]		20,358,000			1.0	Various	International Board of Inquiry (1943)

1 B—bass, Bf—buffalo fish, Cp—carp, F—forage fish, P—panfish, Pk—northern pike, Pick—pickerel, R—rough fish, Tr—trout, W—walleyed pike.
2 Number of fish converted to weight from weight ranges given for each species and size.
3 Number of fish converted to pounds by factor of 0.534 as in Lakes Waubesa and Kegonsa.
4 Includes both commercial and sport yield.
5 Based on 1908 yield.
6 Based on 1939 yield.

small ponds were rejected because the ponds were either constantly or intermittently connected with other bodies of water, permitting contamination from neighboring populations (Tarzwell, 1942: Viosca, 1936).

In some cases, only the numbers of fish are given, and for various species covering a wide range of sizes, so that the weights cannot be estimated (Vestal, 1942a, 1942b; Wales, 1943); and it was therefore necessary to omit these lakes. Ricker and Gottschalk (1941) record the catch from intensive seining over a two-year period of Bass Lake, Indiana. However, the total population was not taken, and the yield from this experimental fishing is not comparable with yields by sport or commercial gear.

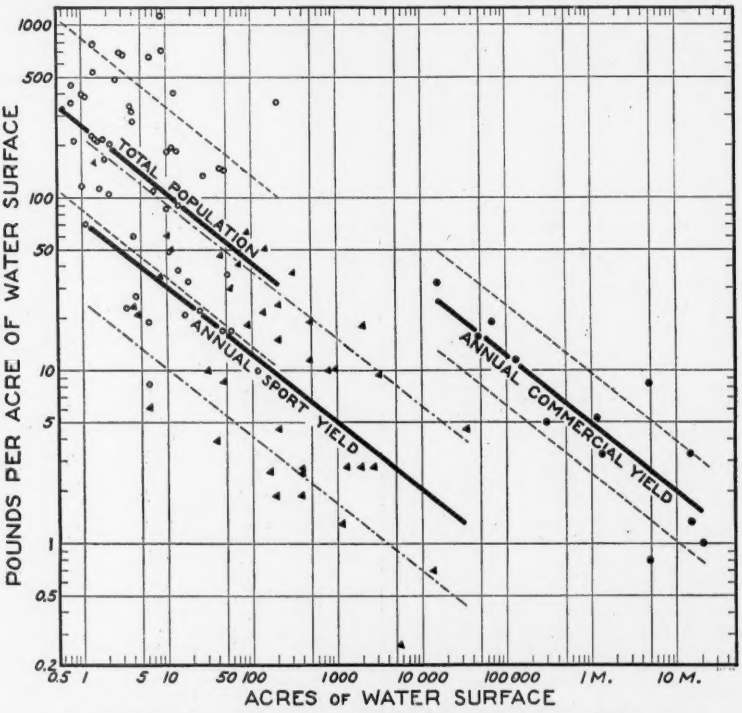

Figure 1. Regressions of logarithms of fish production per acre of lake surface on the total surface area of lakes. [The observations from table 1 are plotted; open circles —total populations per acre, triangles—sport fish yield per acre, solid dots—commercial fish yield per acre. Dotted lines give one standard error of estimate for each regression line.]

There are numerous records of yields from small ponds that were fertilized, and hence not considered typical of natural conditions.

Some data have been omitted because the small number of fish sampled casts doubt on the reliability of the estimated yields. Thus, several of the yields given by Hazzard and Eschmeyer (1938) were not used.

Unfortunately, physical data other than area are lacking for the great

majority of the lakes, so that the analysis had to be confined to a study of the relationship between area and productivity. However, area is an important

TABLE II

CALCULATED FISH PRODUCTION PER ACRE OF LAKE SURFACE

Area of Lake	Total population			Annual yield					
				Sport			Commercial		
	Average	One Std. error		Average	One Std. error		Average	One Std. error	
		plus	minus		plus	minus		plus	minus
(acres)	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds
1	268.5	843	85	74.0	223	25			
3	173.0	543	55	48.3	145	16			
5	140.9	442	45	39.6	119	13			
10	106.9	336	34	30.3	91	10			
15	91.0	282	29	25.8	78	8.6			
20	81.1	255	26	23.1	70	7.7			
25	74.1	233	24	21.2	64	7.0			
30	68.9	216	22	19.8	60	6.6			
40	61.4	193	20	17.7	53	5.9			
50	56.1	176	18	16.2	49	5.4			
60	52.2	164	17	15.1	46	5.0			
80	46.6	146	15	13.5	41	4.5			
100	42.6	134	14	12.4	37	4.1			
150	36.2	114	12	10.6	32	3.5			
200	32.3	101	10	9.46	29	3.1			
300				8.07	24	2.7			
400				7.23	22	2.4			
500				6.62	20	2.2			
600				6.17	19	2.05			
800				5.52	17	1.83			
1,000				5.06	15	1.68			
1,500				4.32	13	1.44			
2,000				3.86	12	1.28			
3,000				3.30	10	1.10			
5,000				2.71	8.2	0.90			
10,000				2.07	6.2	0.69	29.72	58	15
20,000				1.58	4.8	0.52	22.65	44	12
30,000				1.35	4.1	0.45	19.36	38	9.9
50,000				1.11	3.3	0.37	15.85	31	8.1
100,000							12.08	24	6.2
200,000							9.23	18	4.7
500,000							6.44	13	3.3
1,000,000							4.92	9.6	2.5
2,000,000							3.75	7.4	1.91
5,000,000							2.62	5.1	1.34
10,000,000							2.00	3.9	1.02
15,000,000							1.71	3.4	0.97
20,000,000							1.53	3.0	0.78
25,000,000							1.40	2.7	0.71
No. in sample	51			39			12		

factor in production, and is readily obtainable for all of the proposed reservoirs. An estimate of yield based on area alone, therefore, is of considerable value.

In analyzing the data given in Table I, it was first necessary to transform the lake areas and the yields into logarithms because (1) the variance of the yields for different-sized lakes varied with the means of the yields, (2) the distribution of yields was positively skewed. The resulting transformations removed both objections, and enabled the fitting of the linear regression lines of yield on area shown in Figure 1.

The formula for each regression is:

Total population: $\log y = (2.4294 - .4001 \log x)$

Annual sport yield: $\log y = (1.8692 - .3884 \log x)$

Annual commercial yield: $\log y = (3.0355 - .3906 \log x)$

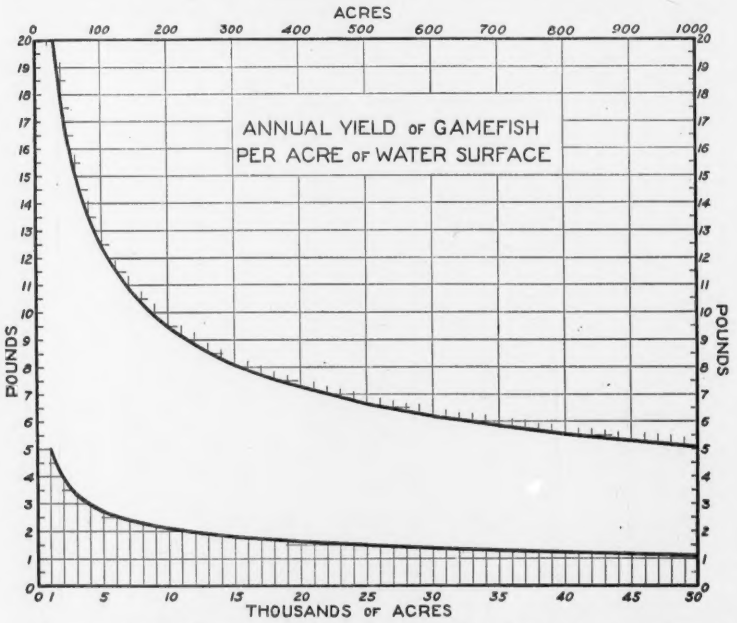

Figure 2. Calculated curves of the annual sport fishery (gamefish) yield in pounds per acre of water surface for lakes from 30 to 50,000 acres in area. [These curves are derived from the antilogarithms of the regression of annual sport yield on lake area shown in figure 1.]

The standard error of estimate was calculated for each regression, and appears (dotted lines) for each regression line in Figure 1. It will be noted that all three measures of fish production show the same rate of decline with increasing size of lake. These data are given in Table II.

No attempt has been made to extrapolate the yields for lakes outside the range of sizes available for each type of data.

The annual yield of game fish is also shown in Figure 2 in such form that it may be conveniently and quickly estimated for lakes of any size from 30 to 50,000 acres in area.

The most obvious characteristic of the yields is the rapid decline in

production per acre as the lakes increase in size. The optimistic production estimates of most fishery experts are not borne out; but it is believed that this is owing largely to the fact that such opinions have been based on the production of very small ponds. For instance, the total population falls from 268.5 pounds in ponds of one acre to only 32.3 pounds in lakes of 200 acres.

In the range of lakes for which total populations are available, i.e., 1 to 200 acres, the annual yield of sport fish varies from 74.0 to 9.46 pounds per acre, or 27.6 to 29.3 per cent of the total population estimate. As the total populations include fish of all sizes, as well as forage and rough fishes not contained in the gamefish catch, it is obvious that the sportsmen annually harvest a very appreciable proportion of the available gamefish of legal size. In many of the lakes analyzed, even the surprisingly low yields shown could not be sustained in the face of intensive fishing.

The commercial catch per acre is much higher than the sport catch in lakes of 10,000 to 50,000 acres. Thus, at 50,000 acres, the sport catch was only 1.11 pounds per acre compared with a commercial catch of 15.85 pounds. This is owing to several causes. First, sport fisheries are carried on in all lakes, while commercial fisheries are confined to selected lakes of higher than average productivity. Second, the commercial fisheries take many rough fishes and pelagic fishes such as lake herring which are not taken by sportsmen. Third, the commercial fisheries usually impose higher fishing intensities.

The yield per acre of lake is probably correlated with the relative area of fertile shallow water, which is generally much less in proportion to total area in the larger lakes than in the smaller ones, as indicated by the difference in length of shoreline. Thus, a circular lake of 503 acres has a shoreline of 3.14 miles, or 0.00624 miles per acre, while one of 50,200 acres has a shoreline of only 31.42 miles, or 0.000626 miles per acre, or about one-tenth as much shoreline per acre. Obviously, the shallow, fertile areas usually are relatively much less extensive in the larger lakes.

There are various reasons for variation in the yield of lakes of similar size. Some of these differences are related to the physical and chemical conditions of the lake itself, such as depth, temperature, heat budget, and the quantities of various nutrient materials available. Others relate to the populations of fish and other organisms present. Even in lakes which are comparable both physically and chemically, the yield may differ considerably because of a difference in the species present.

Making allowances for physical and chemical characteristics, and for annual variations in climatic conditions, the yield of a lake depends in large measure on the natural balance of the populations within the lake. Only occasionally will a lake be producing at its maximum potential capacity. As an illustration, I have drawn upon data given by Foerster (1944) and by Ricker (1937) for Cultus Lake, British Columbia.

Foerster gives the number and weight of the young sockeye salmon migrating out of Cultus Lake each year during a 12-year period. (See Table III.) The balance that had obtained during the first nine years of this period was upset during the last three by the extensive removal of species preying on and competing with the sockeye.

The data of Table III and the curves in Figure 3 show some interesting relationships. At low levels of abundance (under one million) the relation between the number of sockeye and their total weight appears to be linear. This indicates that at these levels the young sockeye were not competing with one another for food, so that the size of the individuals depended on conditions other than competition. Because, then, of natural limits to the growth potential of the individual, the maximum productivity of the lake was not reached with these small populations (Area A, Figure 3). In the absence of competition, increasing size of population was accompanied by increasing total weight of fish produced. At what point competition began to be a limiting factor is not shown by the data, but at higher levels of abundance (in 1933 and 1929) the growth rate of the individual sockeye was greatly diminished. As the natural mortality of sockeye at the higher

TABLE III

YOUNG SOCKEYE SALMON MIGRATING OUT OF CULTUS LAKE, BRITISH COLUMBIA, 1927 TO 1938, INCLUSIVE

Year	Individual weight	Population weight	Population
	(grams)	(kilos)	(thousands)
1927	8.10	7,006	865
1928	5.04	2,197	436
1929	3.06	7,971	2,605
1930	6.55	4,958	757
1931	7.10	2,868	404
1932	7.32	5,783	790
1933	3.67	8,089	2,204
1934	6.53	5,851	896
1935	7.55	3,760	498
1936	8.83	6,587	746
1937	5.96	21,045	3,531
1938	(7.2)	13,154	1,827

abundance levels of 1933 and 1929 was not greater than that at the lower levels, and as there is every reason to suppose that the diminution in growth took place gradually as the population increased, it appears likely that the greatest total weight must have been associated with populations of between 1 and 2 millions of fish. The curves drawn in Figure 3 suggest that at Cultus Lake the maximum yield is in the neighborhood of 9,000 kilograms (about 20,000 pounds) with a population of about 1¾ million sockeye, and that when more sockeye are present the accelerated decrease in growth rate results in a smaller total weight (Area B, Figure 3). The maximum productivity can be reached, therefore, only when sockeye are neither too few nor too numerous. A parallel situation occurs in many lakes in which predators are too scarce to keep down the abundance of perch, resulting in populations of stunted perch.

With the reduction in the numbers of competing and predator species in Cultus Lake during 1936, 1937, and 1938, the size of the individual sockeye increased greatly. In 1937, with a population of 3½ million, the

individual averaged 5.96 grams—nearly double the 3.06 grams for the 1929 population of over 2½ million. Clearly, the removal of competing species greatly raised the level of maximum productivity over that prevailing under natural conditions.

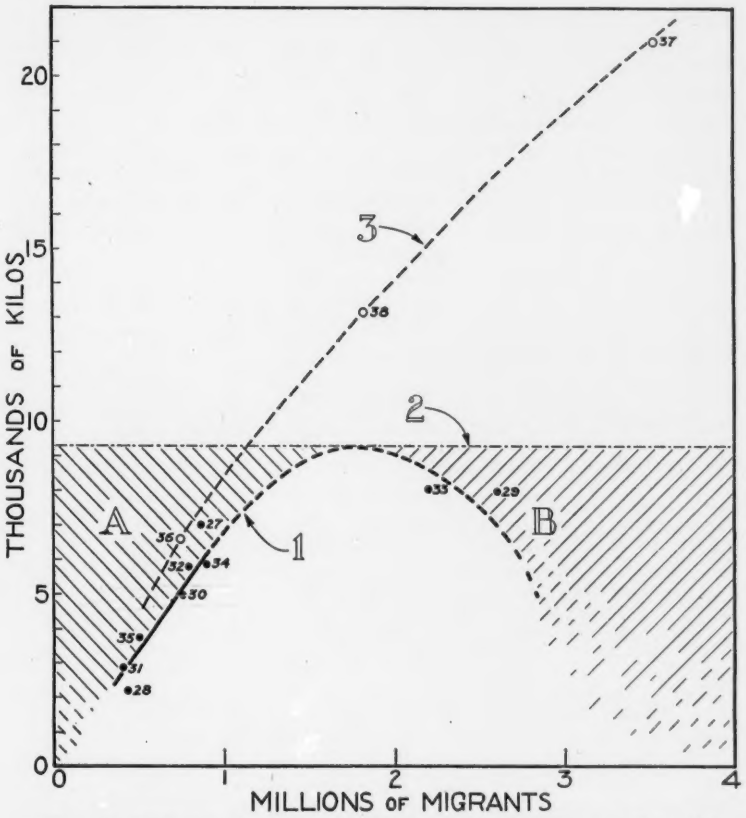

Figure 3. Production of seaward migrants of young sockeye salmon at Cultus Lake, British Columbia, from 1927 to 1938, inclusive. [The year is indicated for each point. Curve 1 shows the probable production in kilograms under natural conditions; the dotted portion was empirically determined. Curve 2 shows the line of approximate maximum production under natural conditions. Curve 3 shows the indicated production for the three years in which the predators and competing species were suppressed. Area A shows the weight lost from the maximum natural production caused chiefly by a population insufficient to utilize the total food supply. Area B shows the weight lost from the maximum natural production when too large a population is present. The suggested cause is the larger amount of food used to sustain life without growth and actual impairment of the food supply owing to the large numbers of fish per unit area.]

These curves of production in natural lakes are at present the only guide for predicting the fish production in proposed reservoirs. A reservoir

usually differs in certain important features from a natural lake. It is more subject to frequent and severe fluctuations in water level. It is more apt to have the bottom covered with layers of silt. The deep water usually is confined to one end, causing unnatural temperature stratifications. All of these features tend to make the reservoir less productive than the natural lake.

Because of the large quantities of organic matter present when first flooded, reservoirs may show a high initial productivity which will be reduced within a short space of years when they have begun to approach as close to a state of equilibrium as a reservoir is likely to attain.

Because the productive capacity of a reservoir must be estimated over a long period of years rather than in the short period immediately following construction when production may be high, it follows that the estimate of yield, based on the analysis of yields of natural lakes, will tend to be too high rather than too low. Nevertheless, it seems desirable that pending detailed studies, these data be used to estimate the productivity of proposed reservoirs. How much adjustment in predicted yield needs to be made for the limiting factors discussed above will remain a matter of opinion until adequate studies of these problems have been made.

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UNITED STATES FISH AND WILDLIFE SERVICE, WASHINGTON, D. C.

Ichthyological Notes

ON A RECENTLY PROPOSED NEW FAMILY OF DEEP-SEA FISHES (BARBOURISIIDAE, PARR, 1945).—In the past I have had occasion to examine some of the strange and rare deep-sea fishes of the family Cetomimidae, so ably revised by Parr (1934, Bull. Bingham Oceanogr. Coll., 4, no. 6). It was therefore with considerable interest that I read Prof. Parr's recent paper (COPEIA, 1945, no. 3: 127–129, pl. 1) on a new fish, *Barbourisia rufa*, from the Gulf of Mexico, for which he erects a new family close to the Cetomimidae.

Parr separates the Barbourisidae (more correctly, Barbourisiidae) from the Cetomimidae by only two characters, the quality of the skin and the presence of pelvic (ventral) fins. Momentarily leaving aside the matter of the skin, I doubt that the presence or absence of pelvic fins should be utilized as a family character in these fishes. My reasons are several.

While the paired appendages are important characteristics in gnathostome evolution, the pelvic fins are of comparatively little use to most bony fishes in swimming (Breder, 1926, Zoologica, N. Y., 4, no. 5). The fact that they are not of primary importance appears to have allowed them to become genetically unstable in many groups, probably by way of the loss-mutations now known to be common in many organisms. Thus we find a whole series of families of telostean fishes (e.g., Clariidae, Pygidiidae, Galaxiidae, Amblyopsidae, Cyprinodontidae, Channidae (equals Ophicephalidae), Ammodytidae, Blenniidae *sensu lato*, etc.) in which some genera possess pelvics and some do not. Moreover, in some species we find that the pelvics are not constant. Wales (COPEIA, 1930, no. 3: 61–70) discussed this matter in *Cyprinodon*, while Myers and Shapovalov (1931, Peking Nat. Hist. Bull., 6, pt. 2: 33–37) indicated that *Channa orientalis* evidently consists of a widespread population (commonly called *Ophicephalus gachua*) which, in one part of the range (Ceylon), commonly lacks the pelvics, while in other parts these fins are lacking only in rare individuals. Subsequent research (unpublished) has served to reinforce our conclusions. Furthermore, it is well known to most persons who handle large numbers of fishes that anomalous, pelvic-less individuals of many species that normally possess pelvics are not rare, even in museum collections. However, the distribution of pelvic-less individuals is interesting. While they are fairly common among fishes with abdominal pelvics (Characidae, Cyprinidae, various siluroid families, Salmonidae, etc.), I have never seen one belonging to the typical percoid genera, in which there is a bony connection between the pectoral and pelvic girdles. While I cannot say that pelvic loss-anomalies do not occur in such fishes, they are certainly far more rare in them than in the abdominal groups. Myers (1944, Proc. Calif. Acad. Sci., ser. 4, 23: 600–601) has given notes on this problem in other fishes.

The Cetomimidae are still placed in the Iniomi, although Parr, reasoning from the case of the superficially rather similar Rondeletiidae, thinks it possible that further work may show them to belong to another order. Be that as it may, *Barbourisia* has abdominal pelvics (the Cetomimidae having none), and although I do not in the least suggest that its generic distinctiveness can be called into question, I do believe that the presence of pelvics in this genus is an exceedingly questionable character upon which to base a new family. The only character to reinforce it is the quality of the skin—finely and densely spinose in *Barbourisia* versus smooth in the Cetomimidae and possibly deciduously scaly in the problematical *Pelecinomimus*. This character does not appeal to me as of great significance, especially in view of our really very meager knowledge of these rare fishes. It is my opinion that the splitting of families has been carried to excess in many groups of fishes (e.g., the deep-water berycoids) and serves no useful purpose. With the Barbourisiidae, I think even Prof. Parr would agree that there is nothing in it to show that it is not very closely related to the cetomimids. I do not hesitate to place it as a subfamily (Barbourisiinae) of the Cetomimidae. Within this family, the gill-count would place it closer to *Ditropichthys* than to *Cetomimus* and *Gyrinomimus*, but again, this character may not be of very great importance, since gill-count is a function of the presence or absence of a slit behind the fourth arch, not of the actual number of gill arches. In other groups, the presence

or absence of a slit may not be of major importance, systematically. *Barbourisia* is very similar in general form to *Gyrinomimus,* and I would not be surprised to see more extensive material and work prove these two genera to be really closely related.—GEORGE S. MYERS, *Natural History Museum, Stanford University, California.*

OCCURRENCE OF URANOSCOPID FISHES OF THE WESTERN PACIFIC GENUS *GNATHAGNUS* IN THE AMERICAN ATLANTIC FAUNA.—While investigating certain trachinoid genera, the description of *Benthoscopus laticeps* Longley and Hildebrand, a presumed new genus and species of Uranoscopidae from deep water off the Dry Tortugas, has come to my attention. This fish bears an extraordinary resemblance to the Japanese and Antipodal genus *Gnathagnus* Gill, and after comparing the various descriptions and examining a Japanese example of *G. elongatus* (Temminck and Schlegel), I do not think that the Tortugas fish is generically distinct. It should stand as:

Gnathagnus laticeps (Longley and Hildebrand)

Benthoscopus laticeps Longley and Hildebrand, 1940, Carnegie Institution of Washington, Publ. no. 517 (Pap. Tortugas Lab., vol. 32); 264, figs. 20–21 (type U.S.N.M. 108879 from off Tortugas, Florida, between 90 and 175 fathoms).

The only important point in which *G. laticeps* would appear to differ at all widely from the Western Pacific species is in the teeth of the lower jaw, which Longley and Hildebrand say are in a single row. *G. elongatus* has them in two, as does *G. innotabilis* Waite, but the rows are very close together (the outer set lower on the dentary than the inner) and the teeth in each row alternate with those of the other. If the teeth of *laticeps* are really different from those of the others, some argument might be put up for recognition of the genus *Benthoscopus,* but examination of the classification of the Uranoscopidae in general indicates that a genus based on this character alone would be out of line with what appears to be a sound and reasonable generic arrangement within the family. In any event, Longley and Hildebrand made no attempt to utilize the lower teeth for generic characterization, and, in fact, did not compare their fish with *Gnathagnus* at all.

G. laticeps is amply distinct specifically, as would be expected. It differs from *elongatus* in the presence of the preopercular process ("spine"), in the somewhat longer head, in the considerably better developed humeral spine, in the shape of the pectoral fin, and in the finer and less evident spotting. It agrees with *innotabilis* in the development of the preopercular process and the head length, but differs in the somewhat better developed humeral spine, the shape of the pectoral fin, the smaller eye, and the finer spots. Both of the Pacific species have a tubular anterior nostril; presumably *laticeps* has this character, although it is not figured or described. The gill-rakers of *innotabilis* are not described. Those of *elongatus* are very low; probably the rakers of *laticeps* are somewhat better developed. For a figure and description of *elongatus,* see Temminck and Schlegel (1847, Fauna Japonica, Pisces: pl. 9) and Jordan and Snyder (1902, Proc. U. S. Nat. Mus., 24: 478). For an account of *innotabilis,* see Waite (1904, Rec. Austr. Mus., 5: 238, pl. 26, fig. 1).

The discovery of a Western Pacific marine genus in the Atlantic is of considerable interest in a zoogeographical way, and deserves notice for this reason alone. However, the fauna to which *Gnathagnus* belongs (the bottom fishes from 10 to 200 fathoms) is perhaps the least known of marine fish-faunas, and trawling and dredging operations almost anywhere at these depths are bound to bring up strange and unknown fishes. Moreover, the genera *Uranoscopus* and *Kathetostoma* have an even wider distribution than *Gnathagnus.*—GEORGE S. MYERS, *Natural History Museum, Stanford University, California.*

AN ERRONEOUS RECORD OF A MARINE RAY (*TRYGON TUBERCULATA*) FROM LAKE CHAMPLAIN.—Dr. Günther (Cat. Fish. Brit. Mus., 8: 481) makes a most interesting error, listing a specimen of *Trygon tuberculata,* purchased from M. Parzudaki, as having been collected in Lake Champlain. This is a manifest error, as this

ray is a marine fish whose range lies far to the south of the fresh waters of the lake in question. Three of Dr. Günther's other specimens were from South America, the island of Grenada, and the United States, while the fourth originated in Sydney, Australia.

According to Jordan, Evermann and Clark (Check list Fishes and Fish-Like Vertebrates, 1930) the range of *Dasyatis guttatus* (with which form they synomynize Günther's American material) is from Surinam to Brazil and Grenada, while Meek and Hildebrand (Marine Fishes of Panama, 1923) report the species from Panama. Evidently the two specimens from North America were not *D. guttatus* or were wrongly labeled as to point of origin. Certainly this applies to the Lake Champlain specimen. A similar statement may be made in regard to the Australian specimen, and, indeed, Fowler (Fishes Philippine Islands, 1941) places the Sydney individual under *Dasyatis latus* (Garman), a form which seems fairly common throughout the warmer portions of the Pacific.—J. L. BAUGHMAN, *311 Peden Avenue, Houston 6, Texas.*

MYSTERY FISH TAG.—On the east side of the Mackenzie River delta, a day's boat travel from the Arctic coast, is located the Canadian Government Reindeer Station. While at this station September 12-16, 1942, I learned, in conversation with Mr. Henry Firth, of a mysterious fish tag. Almost exactly a year before, in September, 1941, Mr. Firth had been fishing with nets in the east branch of the Mackenzie near the station. In his catch was a large whitefish, presumably *Coregonus clupeaformis* like other whitefish taken there, with a metal tag affixed externally. The tag was rectangular in shape, about one inch by one quarter inch in size, and with no other identification on it than a number. Mr. Firth placed the tag carefully to one side on the station wharf, but unfortunately, within a few moments, it was knocked into the river by a dog. He said later, that as far as he could remember, the number resembled a date, like 1870. Presumably, then, there were four digits in the number. These are all the data. The identification of the fish as a whitefish is Mr. Firth's. The size was probably over 10 pounds, indicated by local implications of the adjective "large"; and the fish was probably an old one. The tag may have been affixed at any time in the previous 20 years, and, judging from the wide distribution of whitefish, the specimen could have come from the head waters of the Mackenzie, or from Alaska, or even from Siberia. Inquiry by Prof. J. R. Dymond has revealed no likely source of the tag in Canada or Alaska.—C. H. D. CLARKE, *Royal Ontario Museum of Zoology, Toronto, Ontario.*

AN ALLEGED NEW SPECIES OF MUSKELLUNGE.—This note is presented to call attention to the description of a supposed new species, or subspecies, of muskellunge in an article by Joe Godfrey in the October, 1945, issue of the magazine "Outdoors".[1] Whether or not the supposed new form proves to be distinct, the author has provided a name, *Esox amentus*, a short description and a figure of a mounted specimen. He has also cited type localities and compared his new form with *Esox immaculatus* (*sic*). The author's short description follows: " . . . has a light, almost white skin, with large and distinct vertical bars, called worm tracks, that can be detected the minute it leaps, and the body is short and stubby." The common name, true tiger muskellunge, is applied to this form which is said to inhabit the waters of Little Vermilion and Muskie lakes near Hudson and Sioux Lookout, Ontario.

The name is apparently intended as a patronymic, Mr. Mike Ament of Hudson, Ontario, being honored as the discoverer. In various places in the account the new form is called a sub-species; but the name is printed only as a binomial. The figure of the mounted specimen bears at least some resemblance to supposed hybrids between the Chautauqua and St. Lawrence muskellunge.—S. C. BISHOP, *Department of Zoology, University of Rochester, Rochester, New York.*

[1] "Muskies Unlimited" by Joe Godfrey, Outdoors, October, 1945: 10-11, 36, figs.

Herpetological Notes

REPTILES AND AMPHIBIANS OF SAM A. BAKER STATE PARK, WAYNE COUNTY, MISSOURI.—At the invitation of Walter O. Scruggs, I accompanied the Eastern Illinois State Teacher's College first annual field trip to Sam A. Baker State Park in May, 1940. This trip was repeated in 1941. Delbert Easton and Philip Smith made the trip with the 1941 classes. Both are competent herpetological collectors, and the results of their efforts were made available for my examination by Dr. Charles Spooner of the College staff.

Sam A. Baker State Park is located in Wayne County, southeastern Missouri. The greatest distance between its east to west boundaries is 5 miles, and between the north and south boundaries 4 miles. The total area is 7137 acres. The lowest altitude in the park is 410 feet, the highest 1223 feet. Practically the entire acreage is covered with second growth timber. The hillsides are predominately walnut, elm, hard maple, and various species of oak. The ridges have hickory, elm, oak, and red cedar. The principal streams are the Big and Little St. Francis rivers, Big Creek and Mudlick Creek. Big and Mudlick creeks pass through narrow granite shutins beneath high cliffs. The streams are clear and spring fed. The Big St. Francis has a course of ½ mile in the park; Big Creek has a course of 3 miles. The terrain is mountainous, with Taum Sauk Mountain, the highest point in Missouri, only 18 miles to the north.

A total of 28 species was collected; 9 of amphibians and 19 of reptiles. Representative specimens of each species are deposited in either the Chicago Natural History Museum or the Teacher's College collections. The list of species follows:

Amphibians

Pleihodon glutinosus glutinosus (Green)
Bufo americanus americanus Holbrook
Bufo woodhousii fowleri Hinckley
Acris crepitans Baird
Pseudacris nigrita triseriata (Wied)
Rana catesbeiana Shaw
Rana clamitans Latreille
Rana palustris LeConte
Rana pipiens Schreber

Reptiles

Sceloporus undulatus fasciatus (Latreille)
Cnemidophorus sexlineatus (Linnaeus)
Leiolopisma laterale (Say)
Eumeces fasciatus (Linnaeus)
Diadophis punctatus arnyi Kennicott
Carphophis amoena vermis (Kennicott)
Heterodon contortrix contortrix (Linnaeus)
Opheodrys aestivus (Linnaeus)
Elaphe obsoleta obsoleta (Say)
Lampropeltis getulus holbrooki Stejneger
Lampropeltis triangulum syspila (Cope)
Natrix erythrogaster erythrogaster (Forster)
Natrix sipedon sipedon (Linnaeus)
Thamnophis sirtalis sirtalis (Linnaeus)
Agkistrodon mokeson austrinus Gloyd and Conant
Agkistrodon piscivorous leucostoma (Troost)
Sistrurus miliarius streckeri Gloyd
Chelydra serpentina serpentina (Linnaeus)
Terrapene triunguis (Agassiz)

James A. Peters, *Museum of Zoology, University of Michigan, Ann Arbor, Michigan.*

ADDITIONAL RECORD OF THE NARROW-MOUTHED TOAD IN KENTUCKY.—Heretofore there have been two published records of the occurrence of the narrow-mouthed toad *Gastrophryne carolinensis* in Kentucky. Hibbard (1936, Trans. Kans. Acad. Sci. 39: 277) reported this species as common in the Mammoth Cave region. In 1941 (Copeia, 4: 262) I reported the collection of seven specimens from Floyd's Station, a few miles east of Bowling Green, Warren County.

On the night of August 12, 1942, I secured one specimen from a pond near Science Hill, Pulaski County, Kentucky. Numerous individuals were in full chorus. Further collecting on this and later dates failed to reveal the presence of this species at any other pond in the vicinity.—Roger W. Barbour, *Ft. Ord, California.*

SALAMANDERS FROM NORTHERN CALIFORNIA.—During the second week in April, 1945, I made the following collection of salamanders in Del Norte County, California.

Batrachoseps attenuatus attenuatus (Eschscholtz).—About two dozen specimens chiefly from the redwoods northeast and northwest of Crescent City. The longest was 90 mm. total length, the shortest, 60 mm., with an average length of 79 mm. They had red-brown backs and the upper surfaces of the first part of the legs were tinged with the same bright color. When disturbed under barks or moss they were often found coiled like a little snake with the head near the center, much as described by Taylor and Smith for the Mexican *Thorius dubius* (1945, Proc. U. S. Nat. Mus., 95: 536).

Ensatina eschscholtzii Gray.—The next most abundant form. Both subspecies were found in the redwoods, *E. e. eschscholtzii* being less abundant, *E. e. picta* more frequent. They averaged 90 mm. in length, the shortest 55 mm., the longest 120 mm.

Plethodon elongatus Van Denburgh.—Two specimens from the redwoods just northeast and northwest of Crescent City. One measured 45 mm. the other 80 mm. in length. In these the tail is slightly flattened from side to side and the back above was a deep brown.

Rhyacotriton olympicus (Gaige).—A series of specimens was collected in a brook contributing to a large stream about 4 miles south of Crescent City; 11 larvae and 12 adults were found. The largest adult was 78 mm., the smallest 55 mm. The largest larva was 55 mm., the smallest 33 mm., with an average of 47 mm. The larger larvae were near transformation; apparently the length at transformation here was about 55 mm.

Aneides ferreus Cope.—Three miles south of Crescent City, 8 specimens were found in the very wet, well decomposed center of a decayed fir trunk. The longest was 140 mm., the shortest 85 mm. in length, with an average of 100 mm.

Aneides flavipunctatus (Strauch).—Twenty miles northeast of Crescent City, two specimens were obtained well underground, under stones but in decaying wood. They were 130 mm. long. This is rather far north for this species, a little beyond its recorded range.

Two other species were collected, a half grown *Dicamptodon* and some *Triturus granulosus granulosus*.—WILLIAM A. HILTON, *Dept. Zoology, Pomona College, Claremont, California.*

TAIL LOSS AND REGENERATION IN A PACIFIC ISLAND GECKO.—Examination of a sample of 126 specimens of *Hemidactylus garnotii* taken during a population study on the island of Tinian, in the Marianna Group, indicates that 29 per cent of the females, 33 per cent of the males, and 10 per cent of the juveniles had partially or completely regenerated tails. Eight individuals were observed in which a second regeneration had occurred from an earlier one. Some attempt was made, incidental to other studies with marked lizards, to determine the rapidity of regeneration.

Approximately one-fourth of the individuals marked and released were retained by the tip of the tail until it was broken off. When a partial regeneration was noted, the length of the regenerated section was recorded. Extensive variation was noted in the ability of the lizards to "drop their tails." Some individuals failed to release the tail in spite of violent twisting and pulling. In such instances it was necessary to hold the body of the lizard securely and remove the tail with a strong, sudden pull. Other individuals released the tail when tapped with a lead pencil. The release mechanism is certainly of slight protective value in those individuals having excessive difficulty in separating the tail.

Fifteen individuals that had the tail removed were subsequently recovered 1-3 times each. In 11 the tail was completely regenerated (tail stub of maximum size) after periods of 20, 29, 30, 33, 34, 37, 39, 60, 63, and 65 days. Specific rate of regeneration was determined in some. Thus the tail of two individuals grew 3 mm. in 11 and 12 days respectively. One of these had a completely regenerated tail when collected after 29 additional days. Other records of regeneration were: 1 mm., 6 days; 15 mm., 23 days; 16 mm., 23 days; increase of a stub 13 mm. in length to 20 mm. in 14 days.

Removed tails wriggled violently for 35-80 seconds and responded to a pencil tap by slight movement for an additional 60 seconds.—FRED R. CAGLE, *Zoology Department, Tulane University, New Orleans, Louisiana.*

THE PROBABLE ORIGIN OF THE SOFT-SHELLED TURTLE IN THE COLORADO RIVER BASIN.[1]—The presence of the soft-shelled turtle, *Amyda emoryi* (Agassiz), in the lower Colorado and Gila rivers of Nevada, Arizona, California, and Baja California, is now well known (Linsdale and Gressitt, 1938, COPEIA, 1937: 222–225, figs. 1–3, and references therein; Linsdale, 1940, Proc. Amer. Acad. Arts and Sci., 73: 255; Dill, 1944, Calif. Fish and Game, 30: 179–180; Hardy and Lamoreaux, COPEIA, 1945: 168). Most authors have concluded that this turtle was probably introduced in the Colorado River basin. Data is now presented that strongly favors the hypothesis, suggested by Dill, that the soft-shelled turtle gained access to the Colorado by introduction into the upper part of the Gila River in New Mexico, at about the turn of the century.

In examining the field notes (on file in the Division of Fishes, U. S. National Museum) of the late F. M. Chamberlain, pertaining largely to a collection of fishes from southern Arizona, I found a record of a soft-shelled turtle from the Gila River in the vicinity of Duncan, Greenlee County, Arizona. On April 14 and 15, 1904, Chamberlain examined this section of the river and made the following notes on turtles: "Hard shell turtles were seen but could not be secured, a soft shell was taken. These latter are said to be not rare." Unfortunately this specimen of soft-shelled turtle has not been found and hence its specific identity cannot be absolutely certain. It is believed, however, that it was *Amyda emoryi*, the only species of soft-shelled turtle recorded from the Colorado River system.[2] The type locality of this species is in the Río Grande and it has been recorded from near Mesilla Dam, Dona Ana County, New Mexico, by Little and Keller (1938, COPEIA, 1937: 221). That locality is only about 115 miles from the upper part of the Gila River, likewise in New Mexico.

Chamberlain also recorded catfish (perhaps *Ameiurus melas*, which he collected in the Colorado River at Yuma, Arizona) from the Gila River at this point, with the following comment: ". . . . they are said to have come from a broken pond on the ranch of Lyons and Campbell in New Mexico." There is no question that catfishes (*Ameiurus* and *Ictalurus*) have been introduced into the Colorado basin. In considering the presence of *Amyda* in the Gila River, Chamberlain wrote: "They may have been flooded over at the same time with the catfish."

In attempting to locate the Lyons and Campbell ranch and its owners, a letter was written to the County Clerk, Mr. George Keener, at Silver City, New Mexico. He replied, in a letter dated August 4, 1944, that Mr. Tom Lyons owned the Gila Farm and Lyons Cattle Company, along the Gila River, Grant County, New Mexico (post office, Gila), and that he (Keener) understood that a number of years ago Mr. Lyons built a dyke on the Gila River between Gila and Buckhorn and stocked it with catfish and soft-shelled turtles. Unfortunately, Mr. Lyons died recently and hence this statement could not be verified. In a letter dated August 15, 1944, his widow wrote that the dam was on a ditch from Duck Creek, a tributary of the Gila River. "Blue Catfish," "Black Bass," and "Frogs" were stocked in the lake, but she had no recollection that soft-shelled turtles were also planted.

Amyda emoryi is now common in the lower Colorado (below Boulder Dam) and it has been definitely increasing there in recent years. It is worth noting that introduced animals usually either fail to become established or gain a foothold and then increase rather rapidly. The absence of any records of such a turtle from the collections and reports of the early expeditions of the 1850's to 1900 (Pacific Railroad Surveys, U.S. and Mexican Boundary Survey, U. S. Fish Commission and U. S. Bureau of Fisheries surveys, etc.) and from later faunal works is in agreement with the view that *Amyda* represents an introduction. Mr. Roger Conant told me recently (see also Bogert and Oliver, 1945, Bull. Amer. Mus. Nat. Hist., 83: 396–400) that he has found no records of any *Amyda* from Pacific slope streams in Mexico in which it might be logical to expect soft-shelled turtles if such were native to the Colorado River. On the other hand, the fauna of the Mexican rivers is poorly known.—ROBERT R. MILLER, *U. S. National Museum, Washington 25, D. C.*

1 Published by permission of the Secretary, Smithsonian Institution.

2 Only one other species of soft-shelled turtle, "*Aspidonectes californiana*," has been recorded from the West (see Van Denburgh, 1917, Proc. Calif. Acad. Sci., (4) 7: 33–35; Sacramento River, California), and it obviously was introduced, apparently from China (see also Pope, 1935, *The reptiles of China, in* Nat. Hist. Central Asia, 10: 61).

NOTES ON THE KING SNAKE IN WEST VIRGINIA.—The king snake, *Lampropeltis getulus getulus* (Linnaeus) was recorded from West Virginia by Netting (1936, Ann. Carnegie Mus., 25: 77) on the basis of a preserved specimen from Grant County and reports of two others from Grant and Pendleton counties. We can now add the records for a total of twenty-three specimens (12 collected and 11 observed) from three counties: Hardy, Grant and Pendleton, while Mr. C. B. Heitt, of Moorefield, also reports this snake along the Great Cacapon River in Morgan County. Further collecting might reveal its presence in all counties drained by the Potomac River. There do not appear to have been any reports from the Shenandoah Valley of Virginia. During our collecting over a four-year period at Bridgewater College, Bridgewater, Virginia, we found no trace of this species.

The specimens from West Virginia agree well with published descriptions, tending toward a more intense yellow of the cross bands. Blanchard (1921, Bull. U.S.N.M., 114: 55) points out the progressive decrease in the number of ventrals northward from Georgia in the specimens studied. Specimens from southeastern Georgia have an average of 216 ventrals while those from the District of Columbia and New Jersey average 211. In our series of eleven West Virginia specimens the ventrals average 216. Data on these specimens are presented in the table below:

Number	Sex	Ventrals	Caudals	Cross Bands	Total Length	Tail Length
LWW 98	♀	...	48	41	690 mm.	92 mm.
LWW 131	♀	213	49	41	977	135
WVUM (No number)	♀	217[1]	26	36	1270	....
CM 8719	♀	213	45	..	1010	....
LWW 251	♀	213	41	37	1115	128
LWW 219	♀	215	42	39	554	73
LWW 249	♀	205	44	35	1000	124
LWW 122	♂	219	55	40	1147	161
LWW 143	♂	211	51	37	1255	180
LWW 239	♂	238	52	40	1421	....
LWW 67	♂	214	38	40	1387	151
LWW 245	♂	217	44	34	1222	143

[1] This specimen has a divided anal plate

Our first three specimens were collected during the daytime on the highway in Hardy County. A fourth specimen, badly mangled, was found on the highway near Maysville in Grant County. Two specimens in our collection were obtained in fields of clover, and one in a meadow, bordering the South Branch of the Potomac River. Only two collections were made in forest. The single specimen in the West Virginia University Museum was collected along an abandoned railroad in the South Fork District of Hardy County. The greater number of our records consist of reports of snakes killed in barns, meadows, or during hay or wheat harvest. Three reports from that portion of Hardy County lying between the South Branch Valley and Lost River Valley in the vicinity of Needmore indicate that the king snake may inhabit upland meadows as high as 2000 feet. The farmers reporting these observations know the snake as a "swamp snake" and recall observing it often in their hayfields. The district in question is mountainous and poorly supplied with streams. Only on two occasions has this snake been observed in water.

In July, 1943, while collecting along the bank of Durgon Creek, about 6 miles south of Moorefield, a king snake was observed lying in the shallow water at the edge of the opposite bank. Upon closer observation it was found that it was in the act of attacking a small water snake (*Natrix sipedon sipedon*). The king snake was coiled many times about the entire length of the water snake, and killed it by constriction. The king snake then began to take the *Natrix* in its mouth and starting at the tail appeared to bite it over its entire length at intervals of about 3 inches before beginning the process of swallowing.

Three king snakes kept in captivity from April until October of 1945, accepted as food the following animals: *Sceloporus undulatus faciatus, Natrix sipedon sipedon, Heterodon contortrix, Storeria occipitomaculata, Diadophis punctatus edwardsii, Colu-*

ber c. constrictor, Elaphe obsoleta obsoleta, Carphophis amoena amoena, Triturus v. viridescens, young *Peromyscus leucopus noveboracensis,* and young *Mus musculus musculus.* The stomach of the Grant County specimen previously mentioned contained a portion of the head and some hair of *Microtus p. pennslyvanicus.* A large male (LWW 239) had finished swallowing a 562 mm. *Heterodon contortrix* just before its capture in a meadow. A farmer, living near Durgon, reports that he killed a large king snake in his barn that had eaten two hen's eggs and was lying coiled about three others in the nest. Invertebrates such as locusts, roaches, crickets, beetles, centipedes, millipeds and spiders were refused, as were toads, *Bufo woodhousii fowleri.*

No accurate data were obtained on water consumption, and on only one occasion was a snake observed to drink. On hot days they very often spent a considerable amount of time lying in their pan of water. Six out of nine cast skins were found in the water pan.

King snakes in captivity are ordinarily docile and like to be handled. During the period of shedding, however, when they are temporarily blind, they dislike handling and will frequently strike. When annoyed they vibrate their tails rapidly against the floor of the cage. Use of the cloacal glands is more noticeable during shedding; normally they seldom use this method of defense.

The three captive snakes were maintained in a laboratory where the temperature sometimes went as high as 90° F. but seldom below 55° F. They were well fed and seemed perfectly healthy. During their period of captivity they each shed three times, averaging 27.2 (20-35) days between molts. The average number of days required for complete shedding was 9.6 (7-13). These figures are much less than those given by Stabler (COPEIA, 1939: 228). Our period of observation extended from April until October and did not include the pseudo-hibernation period, and the temperature of our cages was much higher than that of Stabler's. The number of days between molts is counted as the period of time from actual casting until the first indications that molting was again to occur. The number of days required for shedding is from the first indications until actual casting. About seven days before shedding the eye shield became milky and remained so until the third day before actual shedding.—L. WAYNE WILSON, *Moorefield, West Virginia,* and SAUFLEY B. FRIDDLE, *Berkeley Springs, West Virginia.*

PREDATORS EATING TURTLE EGGS IN THE EAST INDIES.—At the time of my visit to the uninhabited island of Bilang Bilangan, in June, 1913, I saw a monitor (*Varanus* sp.) eating the eggs of the sea turtle *Chelonia mydas.* The island is a small, low-lying, forested coral islet about 30 miles off the northeast coast of Dutch Borneo. The *Varanus* was abundant, as were rats, and the rats and turtle eggs were probably the principal food supply of the monitors.

Very few turtles lay their eggs on the shores of the mainland of eastern Dutch Borneo, possibly due to the number of enemies there as compared with the small islands off the coast. However, on several occasions I have seen the sites where turtles have laid their eggs on the beaches of the mainland. The eggs in each case had been devoured by animals; giant wild pigs (*Sus barbatus*) were usually the offenders. When the wild pigs ate the eggs, some of the leathery shells would remain. If a monitor was guilty, its characteristic trail, with sprawling footprints and the winding track of its long tail on the sand, was the evidence upon which I decided what animal had dug out the turtle eggs.—H. C. RAVEN, *The American Museum of Natural History, New York, New York.*

FOOD HABITS OF *DESMOGNATHUS FUSCUS* IN KENTUCKY.—During the course of the senior author's study of the Amphibia of Kentucky, a series of the salamander *Desmognathus f. fuscus* (Rafinesque) was collected from several localities. Analysis of the stomach contents of certain specimens from eastern Kentucky was made by the junior author.

Fifty-three stomachs were examined. These were from Ross Point and Black Mt., near Lynch, Harlan County; Farmers, Rowan County; Ordinary, Elliot County; and Science Hill, Pulaski County.

In the tabulation of food items, there is no assortment of the stomachs on the basis of locality, nor was any effort made to determine the percentage of each item. We have shown merely the food item and the number of stomachs in which each particular item occurred. Frequently, the stomach contents were too badly macerated for definite identification.

Food Item	Occurrence (No. of Stomachs)
Crustacea	
Amphipoda	1
Asellus	3
Chilopoda	
Scolopendra	4
Insecta	
Orthoptera	
Gryllidae	1
Locustidae	2
Ephemerida	
Unidentified naiad	1
Odonata	
Anisoptera, nymphs	1
Zygoptera, nymphs	2
Hemiptera	
Cicadellidae	1
Tingidae	1
Lepidoptera	
Noctuid caterpillar	1
Unidentified caterpillars	7
Coleoptera	
Cantharidae	2
Carabidae	1
Chrysomelidae	2
Curculionidae	2
Elateridae, larvae	4
Mordellidae	1
Scarabeidae	8
Tenebrionidae	1
Unidentified fragments	6
Unidentified larvae	2
Hymenoptera	
Apoidea	1
Formicidae	7
Myrmicidae	2
Vespoidea	1
Unidentified ants	2
Unidentified larvae	4
Diptera	
Chironomidae	
Adults	4
Larvae	3
Mycetophyllidae	1
Tipulidae	
Adults	2
Larvae	3
Unidentified	2
Arachnida	
Unidentified spiders	2
Mollusca	
Gastropoda	1

Varying amounts of inorganic matter and plant tissues were found in several of the stomachs; we suppose that both these materials were accidentally swallowed with animal matter. As might well be expected, the food eaten was found to vary with the availability of the various items.—Roger W. Barbour *and* L. Y. Lancaster, *Western Kentucky State Teachers College, Bowling Green, Kentucky.*

HERPETOLOGICAL NOTES FROM THE WEST INDIES.—During the years 1943–1944 I had opportunity to collect amphibians and reptiles in several localities in the West Indies, and to observe them in life. The field observations have been assembled from successive visits to the places mentioned. At no time was any extensive field work possible.

A large proportion of these specimens are in the U. S. National Museum; some are in the collections of the Chicago Natural History Museum; and others are in the College of Puget Sound Museum of Natural History, Tacoma, Washington.

CUBA

Several of the arid hills within the U. S. Naval Base at Guantanamo were explored, Sept. 1, 1943.

Norops ophiolepis (Cope).—Individuals of this species abound. They are very fast and attempt to escape by speed and dodging, occasionally going down into holes in the ground.

PUERTO RICO

The Caribbean National Forest on El Yunque, the highest peak in Puerto Rico, was visited on August 28, 1943. This was a rainy day and only two species of lizard were observed.

Anolis cristatellus Duméril and Bibron.—Common about buildings and seen on tree trunks in the dense jungle.

Anolis pulchellus Duméril and Bibron.—Found in the lower bushes and in rock slides.

ST. THOMAS, VIRGIN ISLANDS

Most of the collecting at St. Thomas was done in the area about 5 miles north of Charlotte Amalie, up a small valley containing a stream, dry at the time, September 3-12, 1943.

Sphaerodactylus macrolepis Günther.—Individuals of this interesting pygmy gecko are quite widely distributed but not easily seen. These lizards prefer a shady ground, and they are active at night. On being disturbed they progress with rapid extreme bending of the body and stubby tail. It is difficult to see which way they are heading and suddenly they will stop under a leaf, where their dull brown color makes them inconspicuous. Where there is much brush on the ground, it is frequently impossible to pick up any of these little fellows.

Iguana iguana (Linnaeus).—Quite common but difficult to see because of protective green-brown coloration. Iguanas are generally seen in trees, 15 to 30 feet above the ground, though occasionally they descend to the ground. My specimens were secured by natives, who knock them out of the trees with stones and then pounce on them when stunned. The animals do not appear to be disturbed by the missiles whizzing by. One juvenile specimen was obtained.

Anolis cristatellus Duméril and Bibron.—This species is very common in trees, brush, and fences. It is a lively and picturesque member of the island fauna. The males perch themselves upon promontories and extend their bright orange gular folds, peering sidewise at all aggressors. I saw them in the trees as high as 10 or 12 feet. At night I found them sleeping on leaves from 2 to 8 feet above the ground.

Mating was observed. A pair was seen on a stone surface at an angle of about sixty degrees. Both male and female had front legs on the stone. Heads were pointed toward the sky, with the bodies twisted to form "U" shapes. Hind legs and tails were intertwined so that the genital orifices could be in contact. When caught they separated and the male exuded several drops of a glairy, red-staining material.

Several small subcutaneous tumor nodules, about 2 mm. in diameter, were present on the body of each specimen.

Another pair was observed mating on a fence post. Both male and female had their forefeet and most of their bodies on the post.

Anolis pulchellus Duméril and Bibron.—This graceful lizard was quite common. It differs from *A. cristatellus* in frequenting grassy lower areas, though at times it too is found in lower trees. It is more constant in coloration than *A. cristatellus*, being olive green dorsally and light yellow ventrally, these colors sharply separate. The favorite haunt of this species is low brush piles. Even at night individuals were found sleeping

on leaves or limbs overlying thorny masses of brush. Many escaped at night by dropping into this sanctuary.

Ameiva exsul Cope.—Common but difficult to catch. They are invariably on the ground and escape by speed and dodging. At times they skip down into abundant refuge holes, which are about three-quarters of an inch in diameter and all of a foot deep, and extend straight down. These are said by the native boys to be spider holes. More than once the cornered prey escaped by suddenly jumping out as it was about to be excavated. They could not be approached closely enough to catch with a loop. I caught several tails by hand before digging successfully. This species seems to favor rough open ground.

Eleutherodactylus antillensis (Reinhardt and Lütken).—One specimen was found at night in a brush heap, and was easily caught. Its dark brown color turned a light brown while alive in my collecting sack.

Leptodactylus albilabris Günther.—Specimens were found in a drying creek bed under stones and around the edge of pools. Tadpoles were secured in several of the pools, along with recently transformed juveniles.—MURRAY L. JOHNSON, *Dept. of Zoology, College of Puget Sound, Tacoma, Washington.*

A GIANT TIGER SALAMANDER.—On October 4, 1945, an exceptionally large specimen of the common tiger salamander, *Ambystoma tigrinum tigrinum*, was given to a biology teacher at Quincy High School in Quincy, Illinois, by a meter reader. The salamander was captured in a water meter box in a cellar. The top of this type of meter box lies flush with the basement floor, so it may be guessed that the specimen fell into the open-top box while prowling around the cellar floor. It was so much larger than those ordinarily seen that it made me blink in astonishment. The measurements of this specimen, a male, are: total length 330 mm.; tail 180 mm.; greatest width of head 32 mm.

Measurements of a fair sized specimen for comparison are: total length 209 mm.; tail 103 mm.; greatest width of head 20 mm.

The extremely long tail of this unusually large individual was quite weak, in fact the whole creature was much less squirmy and active than the smaller specimen compared with it. The body, however, was very heavily built, showing that an abundance of food had been available.—DAVE LANGEBARTEL, *Quincy, Illinois.*

SUMMER HABITAT OF THE YELLOW-BARRED TIGER SALAMANDER.—On June 14, 1943, the writer visited Paddy Field, Socorro County, New Mexico, an emergency landing field and maneuver area approximately 50 miles southwest of Albuquerque. The field is located on the Mesa Del Oro plateau at an approximate altitude of 6000 feet. The area is arid and miles removed from any stream.

In an attempt to collect plague-infected ground squirrels and other rodents, burrows were gassed and excavated. In several burrows of the spotted ground squirrel, *Citellus spilosoma*, we uncovered the yellow-barred tiger salamander, *Ambystoma tigrinum mavortium*. These salamanders were taken at depths of 14 to 20 inches, where the sand was slightly damp. Four specimens, ranging from 122 to 150 mm. were collected from these burrows. Soldiers clearing the field of candlestick cactus and brush remarked that they had never seen these "lizards" abroad during the night, although they had opportunity to make such observations. Rodent burrows appear to be the residence of these salamanders in the southwestern desert during the non-breeding season. Field examination of the alimentary tract revealed no food.—W. J. HAMILTON, JR., *Cornell University, Ithaca, New York.*

REVIEWS AND COMMENTS

SCIENCE AND SCIENTISTS IN THE NETHERLANDS INDIES. Edited by Pieter Honig and Frans Verdoorn. xxii + 491 pp., 134 figs. Board for the Netherlands East Indies, Surinam and Curaçao, 10 Rockefeller Plaza, New York City, 1945. $4.00.—This large volume consists of a series of articles and reprints by many authors, each dealing with some phase of scientific work in the Dutch East Indies. That the book was prepared while both Holland and the Indies were occupied by the enemy undoubtedly accounts for the uneven treatment and somewhat heterogeneous contents, but the whole makes a work of great value and usefulness. Geography, geology, botany, agriculture, and anthropology are all represented, and even Mayr's recent paper on Wallace's Line is included.

The articles of most immediate interest to COPEIA readers are those by Dr. Herre (Research on Fish and Fisheries in the Indo-Australian Archipelago) and by Dr. Earl H. Myers (A Fisheries Program for the Netherlands East Indies). Dr. Herre gives a general account of ichthyological exploration and fishery research in the East Indies, including the Philippines, with some attention to the improvements in fishing techniques introduced by Japanese fishermen. He especially mentions the gap in food supply caused by removal of these fishermen, and the necessity of filling the gap by the nationals of the area affected.

Dr. Earl Myers, an American oceanographer, sums up the work of the sea-fisheries laboratory at Batavia, and presents a program for future development of marine fisheries by small diesel trawlers and of oceanographic research as a basis for an understanding of fishery problems. He touches upon the main objection to supplying fresh or canned sea fish to the great inland population masses of tropical countries—the economic inability of most of the people to buy any food produced by modern (therefore relatively expensive) methods—but, curiously, entirely misses the corollary—the necessity of the development of cheap and efficient local fresh-water pond fish culture.

In a survey of present and past scientific endeavor in the Indies, it is disappointing to find that the brief notes in Dr. Herre's article are the only mention of the remarkable work done in Java a hundred years ago by Pieter Bleeker, a Dutch army surgeon turned ichthyologist. For nearly twenty years Bleeker's energy and ability made the small and isolated colonial settlement of Batavia one of the greatest ichthyological centers in existence, where not only the ichthyology of the Indies, but of the world, passed under the review of one of the truly great masters of the science, an achievement without parallel in the Indies or in any tropical colonial establishment.—GEORGE S. MYERS, *Stanford University, California.*

OPTICAL INSTRUMENTS. By Earle B. Brown. xii + 567 pp. Chemical Publishing Co., New York City. 1945. $10.—This book is intended to fill the need for a volume thoroughly covering the general field of optical instruments, especially the principles that underlie their construction. There is a chapter on the microscope and even on the grinding of lenses. The book is well illustrated and there is an index.

THE CHEMICAL FORMULARY, Vol. 7. H. Bennett, Editor. Chemical Publishing Company, Brooklyn, xxx + 426. $6.00.—This, a new volume of formulae and recipes adds to a series started several years ago. It covers a very wide field from patented commercial products to simple household aids. Of interest to laboratory workers are such items as ink for marking glass, insecticides, water proofings, cements and filter aids. Several conversion tables and a list of dealers in chemicals are included.—L. A. WALFORD, *Fish and Wildlife Service, Washington, D.C.*

A NATURALIST'S SCRAPBOOK. By Thomas Barbour. Harvard University Press, Cambridge: X + 218, Illus. 1946, $3.00.—The host of friends of the late Thomas Barbour, mostly known to them as TB, will join with the new friends gained by him through his succession of books in welcoming this posthumous addition to the series, which was a rather late by-product of a long life devoted to the preparation of technical papers and the promotion of scientific projects. The present slender volume adds to the fund of anecdote about the Peabody Museum in Salem and the Museum of Comparative Zoology at Harvard, and the museum of the Boston Society of Natural History that so much enlivened *A Naturalist at Large* (1943). The same is true of the two chapters of reminiscences from the honeymoon trip with Mrs. Barbour to the Netherlands East Indies, one on the intriguing Halmahera to which so many GI visitors came close on Morotai in recent years, and one on the astonishingly contrasting Bali and Lombok.

Even Dr. Barbour missed some of the anecdotes about the early M.C.Z.—like the one about the vast collections of mounted birds purchased from Ward's Natural Science Establishment in which each specimen had the feet interchanged. William Critchley, the bird taxidermist at Wards, had developed a method of taking the feet off his bird skins and putting them on last; unfortunately he became mixed up as to right and left, and this idiosyncrasy of his birds was not discovered by Joel A. Allen, the young assistant at the M.C.Z., who gravely O.K.'d them for acceptance. When the mistake was discovered at Wards, the birds were brought back and the necessary pedal corrections made. This is a double-barrelled story, in which one takes a shot at the vagaries of taxidermists with the right barrel and then brings down a scientist with the left.

TB would have loved still more the magnificent picture of his great predecessor Alexander Agassiz, returned from three years in the Pacific, and making his first and immediate visit to inspect the great whale skeleton purchased from Wards and mounted in the main hall of the M.C.Z. during his absence. For, horrified by the sight of the flippers mounted high on the shoulders, where any normal mammal but no whale bears his shoulder blades, the director of the museum burst into a loud commentary such as could scarcely be matched without a background of long contact with seafaring men. Edmond Gueret, of Wards staff, who had mounted the whale, was able to show to Agassiz the properly placed holes to which the bolts holding the shoulder blades could be moved; the sequelae were that Allen's transfer to the New York museum took place soon after, and that Mr. Gueret was never able to obtain the position in New York for which he repeatedly applied.

I must take exception to various comments from reviewers and from my own colleagues, who have expressed admiration for Dr. Barbour's English style. It is true that this reflects something of his extrovert (or partly extrovert) and magnificently careless character; but as English writing it will not bear examination. There is a painful dependence on the which clause; a carelessness about antecedents that makes for obscurity in any writing; and a general carelessness about the choice of words that can only escape those equally careless. These strictures, in our era of newspaperese, need deter no one from the purchase or perusal of *A Naturalist's Scrapbook*.—KARL P. SCHMIDT, *Chicago Natural History Museum, Chicago, Illinois.*

EDITORIAL NOTES AND NEWS

News Notes

A LETTER from DR. LEO S. BERG, Honorary Foreign Member of our Society, has been received recently by DR. REEVE BAILEY. Dr. Berg writes that all of the ichthyologists of the Institute of Zoology, Academy of Sciences of the U.S.S.R., Leningrad 164, are safe and continuing their prewar work. In addition to Dr. Berg, these include DR. SVETOVIDOV, DR. ANDRIASHEV, and DR. LINDBERG. PROF. G. NIKOLSKY is working at the Moskow University and PROF. I. PRAVDIN at the Leningrad University.

American ichthyologists will be disappointed to learn that Dr. Berg's monumental "Classification of Fishes" was issued in 1500 copies only and that these are now out of print. Unfortunately, relatively few copies reached ichthyologists in the United States. A new edition of the fresh-water fishes of the U.S.S.R., revised and completed (in three volumes), is now in press. The first volume of this work was ready before the war, but the composed material was destroyed during a bombardment by the Nazis. Dr. Berg sends his "kind regards and best wishes to you and all your countrymen for contributing so much for our common victory in this terrible war."

The following news of our Danish colleagues has been abstracted from a letter from A. VEDEL TANING to DR. CARL HUBBS. "Here in Denmark we continued work as far as possible and several reports have been issued; these will be forwarded as soon as the international exchange office starts work again. Many of us found a refuge with scientific work during long periods when all connection with the civilized world was restricted to B.B.C. and the Swedish broadcastings; and the result has been some papers published and several in the table-drawer. Of the staff here on Charlottenlund Slot (from the office of The International Council for Exploration of the Sea," Kommissionen for Denmarks Fiskeri-og Havundersgelser, Dansk Biologisk Station og Carlsbergfondets Dana-Ekspeditioner) only the administrative secretary of the intern. Council, CAPTAIN NELLEMOSE, has died during the war, in a German concentration camp just a year ago. No alterations have occurred among the fish men in the Zoological Museum; the old professor AD. S. JENSEN is preparing a survey of the Fishes of Greenland."

THE PHILIPPINE BUREAU OF FISHERIES is again functioning after a fashion, but is laboring under a severe handicap. The Japanese totally destroyed the Bureau of Science library as well as the personal libraries of the scientific workers. Students of fishes and fisheries are asked to give all papers and books which can be spared from their own libraries. Material may be sent to Dr. Albert W. C. T. Herre, Natural History Museum, Stanford University, California. When ready, the Philippine government will arrange for transportation of the literature collected.

The reorganization of the Division of Fisheries after liberation started with the recall by the Secretary of Agriculture and Commerce of Dr. D. V. VILLADOLID, Division Chief, and Mr. H. R. MONTALBAN on July 2, 1945. A skeleton force consisting of several ranking members of the old staff was formed. They immediately attended to the rehabilitation needs of the office. The other members were being recalled gradually to put the machinery of the Division and its District Offices in the provinces to function.

At the outbreak of the war, the offices of the Division were housed in the then newly constructed Department of Agriculture and Commerce building. During the Japanese occupation, this building with all office equipment was used as headquarters of the Japanese Imperial Army. Consequently, the records and reference books were transferred to the Bureau of Forestry building which was totally destroyed in the liberation of Manila.

Side by side with the reorganization and rehabilitation of the office comes the work on the rehabilitation of the Islands' fishing industry. Field men were sent out on inspection to survey the damages on fisheries, particularly the fishing industry. This was done for the purpose of determining the needed materials for rehabilitating this industry. In this connection, the Philippine Government is fortunate to have the help of the United Nations Relief and Rehabilitation Administration. Also in line with this is the hastening of the organization of a school of fisheries projected even before the outbreak of the war to train men for the industry.

The administrative section which handles the administration of the Insular fisheries —as the licensing of fishing boats, issuance of fishpond permits, enforcement of fishery laws and regulations on fishing, etc., is now functioning as before the war. The Salt-water Experimental fish farm at Malabon, Rizal Province, temporarily left in a state of abandon for many months, is now being put into shape for operation with the reconstruction of the dykes and the gates of the ponds. The Experimental Oyster farm at Binakayan, Cavite Province, is also being reconstructed. The Manila propagation ponds located at the Bureau of Science grounds are totally destroyed. The Limnological Station at Tanay, Rizal Province, was also neglected. It may take time to replenish the stock of fresh-water cultivated species that were lost in these two fresh-water fish propagation centers. The plant of the Fish Preservation Station at Estancia, Iloilo Province, is a total loss. Request for funds to rehabilitate the central office and different stations and to replace the losses has already been made to the proper authorities.

From Dr. F. P. Koumans, Curator of Fishes, Rijksmuseum van Natuurlijke Historie, Leiden, Holland, comes news of the museums and scientists in the Netherlands. The Museum at Leiden and the Zoological Museum at Amsterdam were not damaged. Dr. Koumans, during the war, finished MSS on the Gobioidea of British India, the Vol. 8 (Gobioidea) for Weber and Beaufort: The Fishes of the Indo-Australian Achipelago, the Fishes of the Snellius Expedition, and began the study of the sharks and rays (Vol. 13 of Weber and Beaufort). Dr. L. D. Brongersma, Curator of Herpetology of the Leiden Museum, has left for a three years stay in the Netherlands Indies. Of the Netherlands ichthyologists, Dr. H. C. Redeke, investigator on fisheries and fishes of economic value, died in 1945 at the age of 71. Dr. J. D. F. Hardenberg, of the Laboratorium voor het Onderzoek der Zee (Laboratory for investigation of the sea), Batavia, Java, who was a prisoner of war in Singapore, is alive.

Dr. Aage J. C. Jensen of the Kommissionen fra Fiskeri og Havundersögelser is reported in *Science* to be in good health. The activities of the Kommissionen declined greatly during the war but there is good prospect of their being resumed. Dr. Jensen's address is Charlottenlund Slot, Denmark.

Dr. Yaichiro Okada, distinguished Japanese ichthyologist and herpetologist, writes under date of December 19 that he is cooperating with the fisheries section of the military government. He reports that Kiyomatsu Matsubara is continuing his fish studies and is now a professor at the Imperial Fisheries Institute in Tokyo. Katsuzo Kuronuma is recovering from illness. The Research Institute of Natural Resources, with which Dr. Okada was connected, was destroyed May 25, 1945, but the military government has provided a new building to permit the continuation of the work of the institute. Dr. Okada's book on Fresh-water Fishes of Japan, with color plates, was burned while in press.

A post-card from Erna Mohr dated November 22 states that she is well, "though very often I thought I should have no funeral expenses for my own case." The syngnathids, centriscids and echenids of the Hamburg Museum were burned—presumably these were groups held apart for the special researches by Duncker and by Mohr—but, "all the other fishes are safe . . . We must work hard to regain a library. In better

times I must ask you to help us in this task." It is hoped that American colleagues will be liberal and broad enough to respond. Certainly scientists like Erna Mohr and George Dunker are not responsible for the years of hell in Europe.

CARL HUBBS reports that at the University of California, ARTHUR S. LOCKLEY, who served as lieutenant in the Canadian Army, is starting his doctoral research in the fish fauna of the kelp beds, viewed from the ecological and fisheries points of view.

BOYD W. WALKER, who served as a captain in Germany, is beginning his doctoral research on the species and races of California atherine fishes.

GEORGE F. WEISEL, JR., former Navy lieutenant, is continuing doctoral research on the hormonal basis of reproduction in fishes.

CLARK HUBBS, who participated in the Leyte and Okinawa campaigns as technical sergeant, expects to work on the fish fauna of the Gulf of California, from the viewpoints of systematics, zoogeography and evolution.

The California Division of Fish and Game reports the following men returned from military duty: J. ALFRED APLIN, now at the California State Fisheries Laboratory, HOWARD MCCULLY, now at Stanford University, and JOHN G. CARLISLE now working on salmon problems in the San Joaquin Valley. S. ROSS HATTON, formerly of the California State Fisheries Laboratory, is now working for the Terminal Island Sea Foods Company at Terminal Island, California.

LT. J. LINSLEY GRESSITT, of the Naval and Medical Unit No. 2, writes that he has been stationed most of the time since last April on Guam, except for some brief visits to Luzon, Okinawa and Japan. He participated in the evacuation of allied POW's from Japan, and has assisted in some preliminary atomic bomb victim surveys.

DR. WM. A. GOSLINE, after two years at the Museu Nacional, Rio de Janeiro, spent in researches for the food supply program of the Brazilian Government, has joined the staff of the Museum of Zoology, University of Michigan, as assistant Curator of Fishes.

DR. EDWARD H. TAYLOR, on his release from service, has resumed his duties at the University of Kansas, and DR. JAMES OLIVER, USNR, has returned to his assistant curatorship at the American Museum.

WILFRED T. NEILL, JR., has joined the Biology staff of the Richmond Academy, Augusta, Georgia.

As COPEIA goes to press we are informed of the death of Major STANLEY SMYTHE FLOWER, 74 years of age, at Old House, Tring, England, on February 3, 1946.

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